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CONTENTS

	PAGE
*Railway Shops. By R. H. Soule	121
Railroad Y. M. C. A	123
*Power Plant at Weehawken. West Shore Railroad	124
Machinery Orders for Railroads	128
*Motors Applied to Old Tools. Wright	129
*Editorial Correspondence	130
*Passenger Locomotive, Chicago & Alton	133
*Back-Geared Crank Shaper	135
Coke as Locomotive Fuel	135
Specifications for Locomotive Cylinders	136
Specifications for Malleable Castings	136
The Technolexicon	136
*Lawson Improved Dump Car	137
Mess Rooms in Railroad Shops	139
Protecting Coating for Air Hose	139
Reduced Clearance on a Locomotive	139
†Critical Study of Roundhouses	140
†Locomotive Repair Records	140
†Information	140
Locomotive Repair Records	141
Equalizing Prairie Type Locomotives	141
Suggestions	144
Numbering Shop Men	144
Rectangular vs. Square Engine-Houses	144
*A Suggestion in Cranes	144
Locomotive Failures in England	144
Boiler-Shop Tools	145
*The Corrington Air-Brake	146
Gas Engines from Furnace Gas	147
*Motor-Driven Machine Tools	148
Card Index in Drafting Room	150
Locomotive Wheel Lathe Record	151
*Standard Smokeboxes. Southern Railway	151
*Hydraulic Press for Cylinder Bushings	151
Good Air-Brake Work	151
*Double-Head Boring Machine	152
*Smith One-Belt Countershaft	152
*Passenger Locomotive. Vandalia Line	153
*Visit to Works of J. G. Brill Co	153
*Heavy Power Bending Roll	155
Overloading Locomotives	155
*Star Improved Indicator	156
Personal Notices	156
Locomotive Frames	157
*Object-Lesson in Firebox Sheets	158
Oil Fuel on A., T. & S. F. Ry	158
Books and Pamphlets	159
Notes	160

*Illustrated articles.
†Editorials.

RAILWAY SHOPS.

BY R. H. SOULE.

XII

THE ROUNDHOUSE.

At the annual convention of the Master Mechanics' Association in 1900 it was decided to appoint a special committee to report on the question, "What should be the arrangement and accessories of an up-to-date roundhouse;" the committee reported in 1901, was continued and enlarged, and reported finally in 1902, since which time the conclusions then reached have been reflected in many cases of modern practice. The systematic and thorough inquiry into and discussion of this important subject was the logical result of events; the gradual increase in the size and weight of engines, and the increased mileage required of them (both on account of press of business and more critical operating supervision) had emphasized the fact that promptness, thoroughness, and efficiency at roundhouses was the keynote of the situation, if improved results were to be expected. The result of this agitation was salutary, as it is evident that the present temper of operating officers is to provide roundhouse facilities which are fully up-to-date.

The roundhouse plan is always mapped out with reference to its possible ultimate completion to a full circle, even though but a few stalls are built at the outset; it is therefore necessary to assume the number of stall segments corresponding to the full circle, and, further, it is desirable to simplify the engineering work of laying out the structure on the ground by adopting such a total number of stalls (in the full circle), that the central angle subtended by each may be expressed in degrees and integral minutes (without the use of seconds of arc). Assuming a minimum of 30 stalls and a maximum of 60 stalls as limits within which practice is likely to be confined, it is found, by resolving 21,600 (minutes of arc corresponding to 360 degrees) into its prime factors, and making combinations of the same, that the total number of stalls in the full circle must be either 30, 32, 36, 40, 45, 48, 50, 54, or 60.

Again, it is necessary to assume the center to center distance between door posts on the inner circle; this will usually be from 13 ft. to 14 ft.; there are so very few cases, in practice, outside of these limits that it is unnecessary to consider them; the 13 ft. spread is practicable with structural steel posts, and the 14 ft. spread may be necessary with timber posts; in any case it is well to make the working clearances through these track pit doors as liberal as possible, as doors warp, tracks settle, and engines lean, and combinations of these factors may wreck doors or cabs; on the other hand, the greater this door post spread, the greater the diameter (both inside and outside) of the roundhouse, and therefore it must be judiciously chosen.

The Master Mechanics' report of 1902 advised that the span should be 80 ft. and several roundhouses of that span were subsequently built in various parts of the country; the Lambert's Point house of the Norfolk and Western, although built in 1891, had a span of 84 ft., and there has been a marked tendency to increase the span over the 80 ft. standard recommended in 1902; for instance the houses at Mason City, Ia. (C. & N. W.) and Chicago, Ill. (C. & N. W.), are of 84 ft. span, while those at Fairmont, Va. (B. & O.), Glenwood, Pa. (B. & O.), and Holloway, O. (B. & O.), are of 91 ft. span, or approximately 90 ft. from center to center of roof truss bearings, which appears to be the maximum so far attained.

The cross section adopted will be influenced largely by the conception of economy which prevails in the minds of the officers having the deciding voice; if first cost is the prime consideration, a flat (or nearly flat) roof supported by posts, and with minimum head room, will probably be used; if operating efficiency, and economy in handling and maintaining engines are the principal objects in view, posts will be eliminated and head room increased.

Fig. 7 gives six cross sections from actual practice; it will be noticed that Moline has three posts, Collinwood and Rensselear two, and Lambert's Point one, while Fairmont and McKees' Rocks have none; in all these designs the engines head out which may be accepted as standard practice; this gives maximum space at the machinery end of the engine where most of the repair and maintenance work is to be done; good light being very necessary, and good height contributing to good ventilation, it is logical to aim at construction which makes the outer circle wall higher than the inner circle wall, and which brings the peak of the roof over the general region of the smoke stack and the steam dome; this is accomplished at Lambert's Point, Fairmont, and McKees' Rocks. Compromise sections are found at Glenwood, Pa., and Holloway, O. (B. & O. points), where a section similar to Moline is used with the left hand post omitted, a deep truss being introduced between the outer wall and middle post, thus eliminating that particular post which would be most in the way of the repair men. In some Russian and French roundhouses the house and turntables are covered by a roof supported on arched trusses but this of course implies a full circle, and there are few such houses in this country. The Central Railway Club recommended, through a committee report in 1900, that roundhouse roof trusses should always be made of timber, as metallic trusses cause moisture to condense and drip, but this recommendation is seldom followed.

Overhead electric traveling cranes are being introduced in roundhouses; at Wilmington, Del. (P. R. R.) a new house has been put up with provisions for a crane runway to carry a

crane covering the outer portion of the span (the crane has not yet been installed, however); in this case smoke jacks can not be used, and some form of roof ventilator must be depended on to carry off the smoke; it is understood that at another Pennsylvania roundhouse there will be a traveling crane over the inner segment, which arrangement will permit of the use of smoke jacks as usual. The Baldwin Locomotive works have a new roundhouse at 27th st., Philadelphia, with a traveling crane in actual use.

The length of the engine pits varies, but it will be noticed from Fig. 7 that 60 ft. is common practice. Ventilation can best be considered in connection with the cross section, and different arrangements will be seen in Fig. 7. Lambert's Point is without smoke jacks, but has a continuous slatted peak ventilator which has been found to be very effective, and is well adapted to the mild climate of Virginia; Fairmont and McKees' Rocks have both smoke jacks and peak ventilators on the same axis; Collinwood has smoke jacks with auxiliary ventilations through collars around them, and other places have various combinations of smoke jacks and special ventilators of various types.

and in their final report of 1902 made no mention of it whatever.

Tables 19 and 20 give the essential engineering data for laying out roundhouses of from 30 to 60 stalls (in the full circle) having inner door posts, either 13 ft. or 14 ft. centers, and having a span of either 80 ft., 85 ft., or 90 ft.; the diameters of the outer circles and the lengths of the outer chords for spans intermediate between 80 ft. and 85 ft., or between 85 ft. and 90 ft. may be interpolated in either table. The extreme case would be a 60 stall house of 90 ft. span with door posts 14 ft. center to center, in which case the diameters would be, inner circle 267.5 ft., and outer circle 447.5 ft. It will be noticed that all the values in the tables progressively increase, excepting only the lengths of the outer chord, which decrease, and cause a corresponding reduction of working space at and near the front ends of the engines; this fact should be borne in mind in selecting a standard roundhouse, and may account for the fact that full circles of 45, 48, and 50 are popular, although other considerations (such as the amount of land available) of course, have a large influence.

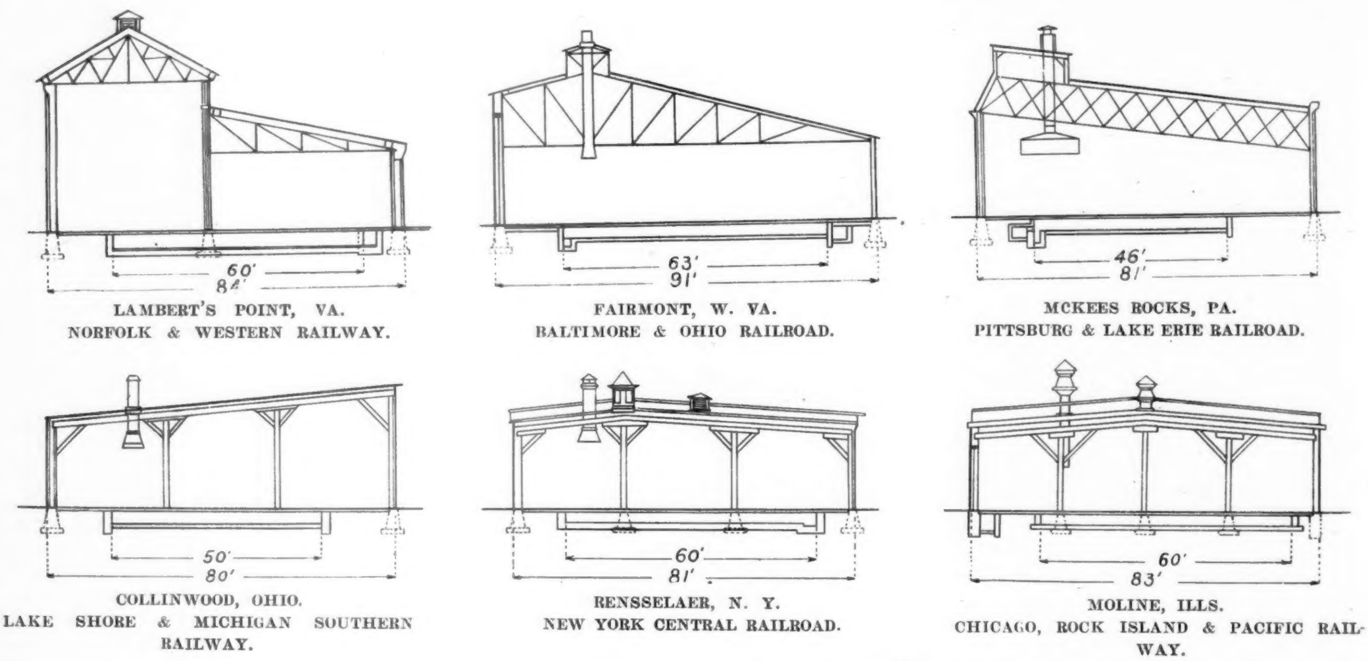


FIG. 7.—SECTIONS OF SIX REPRESENTATIVE ROUNDHOUSES.

Smoke jacks are made in various forms; either metal or wood, and, if metal, either of sheet iron or cast iron, either fixed or telescopic, and, latterly sometimes swinging, so that when dropped over the stack of the engine they may be withdrawn without damage to the smoke jack; wooden smoke jacks are usually given at least three coats of fire proof paint, and are put together with copper nails and brass screws; at Glenwood, Pa. (B. & O.), and McKees' Rocks, Pa. (P. & L. E.) the cone bottom is replaced by a pyramidal part which, while only a little wider than the head of the stack, is elongated in the direction of the track (at McKees' Rocks to about 14 ft.) so that the engine does not have to be placed with its stack on the axial line of the smoke jack, but may stand several feet either way from a central position. In some cases smoke jacks are provided with dampers, to prevent down drafts of cold air, when the stall below is not occupied, but they are something extra to handle and of doubtful value. At the new roundhouse of the Baldwin Locomotive Works, where regular smoke jacks can not be used on account of overhead cranes, a special curved siphon pipe is dropped into position by the crane when it is desired to fire up an engine; the upper end of the pipe covers the top of the smoke jack and the lower end connects with an underground flue which leads off to a brick stack. The difficulty of the smoke jack problem is illustrated by the fact that the Master Mechanics' Committee in their preliminary report of 1901 said that on this detail they were "unable to agree,"

In many roundhouses fire walls are introduced dividing the house up into segments, and in one case at least (Sault Ste Marie, Canada) the entire structure is fire proof, the walls being of stone, the posts and beams of steel, and the roof of concrete on expanded metal. A most essential point from an operating standpoint is that tracks on opposite sides of the turntable shall be absolutely in line with the turntable track when the turntable is in either of its two reversed positions. The actual number of stalls to be erected at a given roundhouse point is dependent on many operating conditions, and need not be considered here. At West Albany, N. Y. (N. Y. C.) there are two half roundhouses instead of a single full circle house; although this arrangement may have been necessitated by land limitations, yet it possesses several advantages from an operating standpoint; the breakdown of a turntable can block in only half the engines, the engines in both houses are very accessible to and at minimum distance from the machine shop annex, which is in an intermediate T shape building, and finally additional tracks for standing engines on can be provided, radiating from the two turntables, so that the combination has the housing capacity of one full house, but the standing capacity of two full houses.

Turntable diameters range from 70 ft. up, only one recorded installation since 1902 having the smaller diameter of 65 ft.; on the other hand, at Moline, Ill. (C. R. I. & P.), the diameter is 75 ft. and at Fairmont, Va., Glenwood, Pa., and

Holloway, O. (B. & O. points), it is 80 ft. The larger tables are revolved more easily on account of the longer leverage, give more latitude in balancing engines of different types and with different loads of water and coal in their tenders, and enable hostlers to move engines more freely and make better time in handling them. As frogs at the turntable pit edge are to be avoided where conditions permit, a column has been introduced in tables 19 and 20 to indicate the minimum possible diameters which can be used; the values are based on the use of 80-lb. rails (Am. Soc., C. E. section), with a minimum distance of ¾ in. from base to base at edge of pit; it will be seen that frogs may be avoided by using a 70-ft. turntable with 40 or less stalls in the full circle, or an 80-ft. turntable with 45 or less. Sometimes the number of stalls (in the full circle) and the turntable diameter are so chosen as to permit of "nose" frogs, or frog points, which are not as objectionable as full frogs; such is the case at Moline, Ill. (C. R. I. & P.), where a 48 stall (in the full circle) house has a 75-ft. turntable.

Drop pits are absolutly essential in every large roundhouse, and are very convenient and useful even in a small one; in the latter case the minimum requirement is a drop pit for engine truck wheels, but a still better arrangement is a combination pit which will permit of dropping and withdrawing a pair of truck wheels, and will also permit of dropping, without withdrawing, a pair of driving wheels, so that a journal or a driving box may be examined; in larger houses separate drop pits for truck wheels and driving wheels are justified. The St. Louis & San Francisco have a form of continuous ring pit in some of their roundhouses so that a pair of truck wheels may be removed from any engine standing in the house; in many places there are examples of drop-pit installations on a liberal scale, as, for instance, at Fairmont, Va. (B. & O.), where, in a 24 stall house there are drop pits for drivers under five tracks, and for truck wheels under two. Drop pits are usually rectilinear, in which case the pit can be at right angles to not more than one track, but at Elizabethport, N. J. (C. R. R. of N. J.), and Dubois, Pa. (B. R. & P.), they are built to an arc of a circle, and therefore cross all tracks at right angles. Drop pits have hitherto been usually equipped with hydraulic hand-power lifts, but it is understood that the new Blair Furnace, Pa., house of the P. R. R. is to have drop pits of novel construction and fitted with electric lifts.

TABLES 19 AND 20.—DATA FOR ROUNDHOUSES.

Number of Stalls in Full Circle.	Central Angle per Stall.	Diameters (in Feet.) Turntable, Min., Without Frogs.	Inner Circle.	Outer Circle. 80-Ft. Span.	85-Ft. Span.	90-Ft. Span.	Outer Chord (in Feet). 80-Ft. Span.	85-Ft. Span.	90-Ft. Span.
		Table 19—With Door-Posts 13-Ft. Centers.							
30	12—0	51.81	124.40	284.40	294.40	304.40	29.73	30.77	31.82
32	11—15	55.26	132.70	292.70	302.70	312.70	28.69	29.67	30.65
36	10—0	62.14	149.20	309.20	319.20	329.20	26.95	27.82	28.69
40	9—0	69.03	165.70	325.70	335.70	345.70	25.56	26.34	27.12
45	8—0	77.65	186.40	346.40	356.40	366.40	24.17	24.86	25.56
48	7—30	82.82	198.80	358.80	368.80	378.80	23.47	24.12	24.78
50	7—12	86.26	207.10	367.10	377.10	387.10	23.05	23.68	24.31
54	6—40	93.16	223.60	383.60	393.60	403.60	22.30	22.89	23.47
60	6—0	103.50	248.40	408.40	418.40	428.40	21.37	21.91	22.42
		Table 20—With Door-Posts 14-Ft. Centers.							
30	12—0	51.81	134.00	294.00	304.00	314.00	30.73	31.78	32.82
32	11—15	55.26	142.80	302.80	312.80	322.80	29.68	30.66	31.64
36	10—0	62.14	160.60	320.60	330.60	340.60	27.94	28.81	29.68
40	9—0	69.03	178.40	338.40	348.40	358.40	26.55	27.34	28.12
45	8—0	77.65	200.70	360.70	370.70	380.70	25.16	25.86	26.56
48	7—30	82.82	214.10	374.10	384.10	394.10	24.47	25.12	25.78
50	7—12	86.26	223.00	383.00	393.00	403.00	24.05	24.68	25.30
54	6—40	93.16	240.80	400.80	410.80	420.80	23.30	23.89	24.47
60	6—0	103.50	267.50	427.50	437.50	447.50	22.37	22.90	23.42

The roundhouse floor should be hard and firm and non-absorbent; a wooden floor is comfortable to work on, but if properly maintained is very expensive in the long run; for a thoroughly satisfactory floor a concrete base seems to be necessary, but the wearing surface may be either cement or vitrified brick, and if the latter either simply bedded in sand or flushed with tar. Between end of pit and entrance doors a flangeway through the concrete can be nicely formed by putting a rail on its side with its head against the web of the track rail.

Day lighting has been touched upon when considering the best form of cross section; night lighting is best accomplished by incandescent electric lights inside the house, and arc lights outside; a good arrangement of the inside lights is a ring of lights in the outer gangway always burning, and rows of lights down each bay to be turned on or off as needed; there should be plenty of sockets for portable lights either on posts or in pits or both. Heating by hot air from a fan is most satisfactory, especially if the dampers are so arranged that a large volume of hot air can be delivered under an engine in one pit and quickly thaw it out.

In an up-to-date roundhouse complete piping systems are provided for steam, air, cold water, hot water (for washing), and blow off; the Master Mechanics' committee recommended that the steam and air lines should be overhead, and all others in an annular pit. Duplex pumps yielding not less than 100-lb. hose-nozzle pressure should be installed for washout purposes.

Every large roundhouse should have, and most recent ones do have, an annex in which are usually housed a machine shop, smith shop, engineer's room, store house, oil house and power plant; the annex at Clinton, Ia. (C. & N. W.), for instance, is 60 ft. by 140 ft., and at Glenwood, Pa. (B. & O.), is 70 ft. by 131 ft. The oil house is, of course, often isolated. The outfit of tools generally considered essential for an active roundhouse should include one small lathe (12 to 16 ins.), one large lathe (24 to 30 ins.), one good strong drill press (30 to 36 ins.), one bolt cutter, one shaper (stroke 24 ins. and up), possibly a planer (30 by 30 ins. at smallest), and a blacksmith forge; this list may be enlarged at very active points.

The track approaches to a roundhouse are often a point of congestion, and their arrangement has been given much study in recent years; the essentials are separate tracks for incoming and outgoing engines, convenient facilities for supplying coal, sand, and water, and for removing ashes; the coal, sand and ash facilities should be on the incoming tracks, and the water facilities accessible from both incoming and outgoing tracks. The Pennsylvania is introducing inspection pits on roundhouse approach tracks, the idea being that if repairs are found necessary, material can be assembled, arrangements made in advance (while engine is still on the ash pit) and time saved.

At the Union Station, St. Louis, owing to space restrictions, 62 stalls are provided in three rectangular houses which are served by five transfer tables working in three pits; in such an arrangement there are no waste corners, but on the other hand the plant must be supplemented by a turntable or a Y on which to turn engines.

(To be continued.)

THE RAILROAD Y. M. C. A.—The outlook for 1904 includes prospective buildings at two points in Ontario, one in Alabama, two in Arkansas, two in Indian Territory, one in Kansas, one in Maine, two in Massachusetts, two in Michigan, one in Missouri, one in New York, two in Utah, one in West Virginia. These buildings are to be erected with the co-operation of the railroad men and twenty railroad systems. In most cases the railroad appropriations have been made conditional upon a portion of the cost being secured in subscriptions from the men and their friends. At several of these points the buildings are now being erected. The growth of the Young Men's Christian Association is due, not only to the fact, that it has the hearty support and co-operation of the railroad corporations and their employees, but also very largely to the fact that the associations have always had the influence and practical co-operation of far-sighted, broad-minded and liberal Christian men. The work as organized and conducted, adapts itself to railroad men of every branch of service, and permits all of whatever belief to enjoy the benefits of membership.

An international engineering congress will be organized by the American Society of Civil Engineers in connection with the World's Fair at St. Louis. Information as to the membership and papers to be presented may be obtained from Mr. C. W. Hunt, secretary of the American Society of Civil Engineers, New York City.

AN IMPORTANT NEW TERMINAL-YARD LIGHTING AND POWER PLANT.

WEEHAWKEN, N. J.

WEST SHORE RAILROAD.

III.

(*Continued from page 92.*)

BOILER FEED AND BLOW-OFF PIPING.

The care taken in the design at the Weehawken power plant, of these two very important features of the boiler equipment, the boiler feed and blow-off piping, makes them very interesting and worthy of note. The troublesome leakage at blow-off valves is carefully provided against and the possibility of shut down of any boiler due to lack of feed water supply will be eliminated by a duplicate system of feed piping. The arrangements of both the feed and the blow-off systems of piping are clearly shown in the two basement plans which are presented in this article.

The boiler feed piping system is carried entirely in the basement just below the boiler room floor, extending above at points to connect with boiler feed pumps, economizers, feed water heater and boilers. The duplicate sources of water supply for the boiler feed pumps are shown at the southwest corner of the boiler room basement, where connections are made with the high and low pressure water mains of the city of Weehawken, N. J.; the duplicate suction connections, each of which is of 6 inch pipe, lead through Worthington water meters to the feed pumps. The pumps deliver through the feed water heater, in the boiler room, to the economizers, and from thence on to the duplicate 4 inch feed mains in the basement, from which the feed connections are made to the boilers. The feed connections to the boilers, which are made at the base of each of the three steam drums of each boiler, are clearly shown, together with other important connections in the boiler feed system, in the inset supplement illustrating this power plant, which appeared in the preceding issue.

The connections provided in the feed system are very flexibly arranged. Either the feed water heaters, or the economizer, may be by-passed, or both may be by-passed at once; in this way either one, or both of the feed pumps, may deliver either cold or heated water to the boilers through either leg of the duplicate system of feed piping. The necessary valves are conveniently arranged so as to make these changes possible with the least amount of trouble. The entire feed system is piped with the "special full weight" grade of galvanized mild steel pipe and is tested with the "high pressure" test of 400 lbs. hydrostatic for 48 hours. Excessive pressure in the feed system, due to a delivery pipe from the pump becoming clogged, is prevented by a relief valve located in the delivery of each pump.

Two boiler feed pumps are provided in duplicate, each of which is capable of feeding the entire equipment of boilers. The pumps are Worthington outside-packed-plunger pressure pumps with "pot" valves fitted to handle cold water; each has steam cylinders 12 ins. in diameter and water cylinders 7½ ins. in diameter, with a common stroke of 10 ins. The capacity of each pump is 22,000 gallons of water per hour delivered against a pressure of 300 lbs., with a piston speed of not over 100 ft. per min. They are located conveniently for access in the open space on the boiler room floor adjacent to the base of the stack. The feed water heater is located directly above the feed pumps upon a special steel platform, as shown in the boiler room view in the inset. It is a vertical Wainwright, closed tube type heater, having 300 sq. ft. of heating surface; the guarantee accompanying this heater is that it is capable of raising the temperature of 70,000 lbs. of feed water per hour from 40 deg. F., to 100 deg. F., with 7,000 lbs. of exhaust steam at atmospheric pressure.

The blow-off piping system includes not only the three blow-off connections from each boiler, but also one from each economizer and one from the feed water heater. All these deliver to a 4 inch blow-off main in the basement which leads to a special blow-off tank, of interesting design, which is for the purpose of allowing the vapor to collect and escape into the atmosphere. From this tank a 6 inch overflow line leads to the sewer. The blow-off connections from each boiler consist of three 2½ inch asbestos-packed blow-off cocks at the mud drum, each of which is connected to the blow-off main through a 2½ inch Cadman angle blow-off valve. Thus each of the three separate connections are provided with two special valves, in series and located as close to each other as possible—the most approved practice for preventing destructive and annoying leakages. The entire piping for the blow-off system is flange connected, and tested for high pressure service. An important feature of this piping system is that tees and crosses are used in place of elbow fittings at all points possible, blank flanges being applied on the vacant sides to permit ready access for cleaning out pipes.

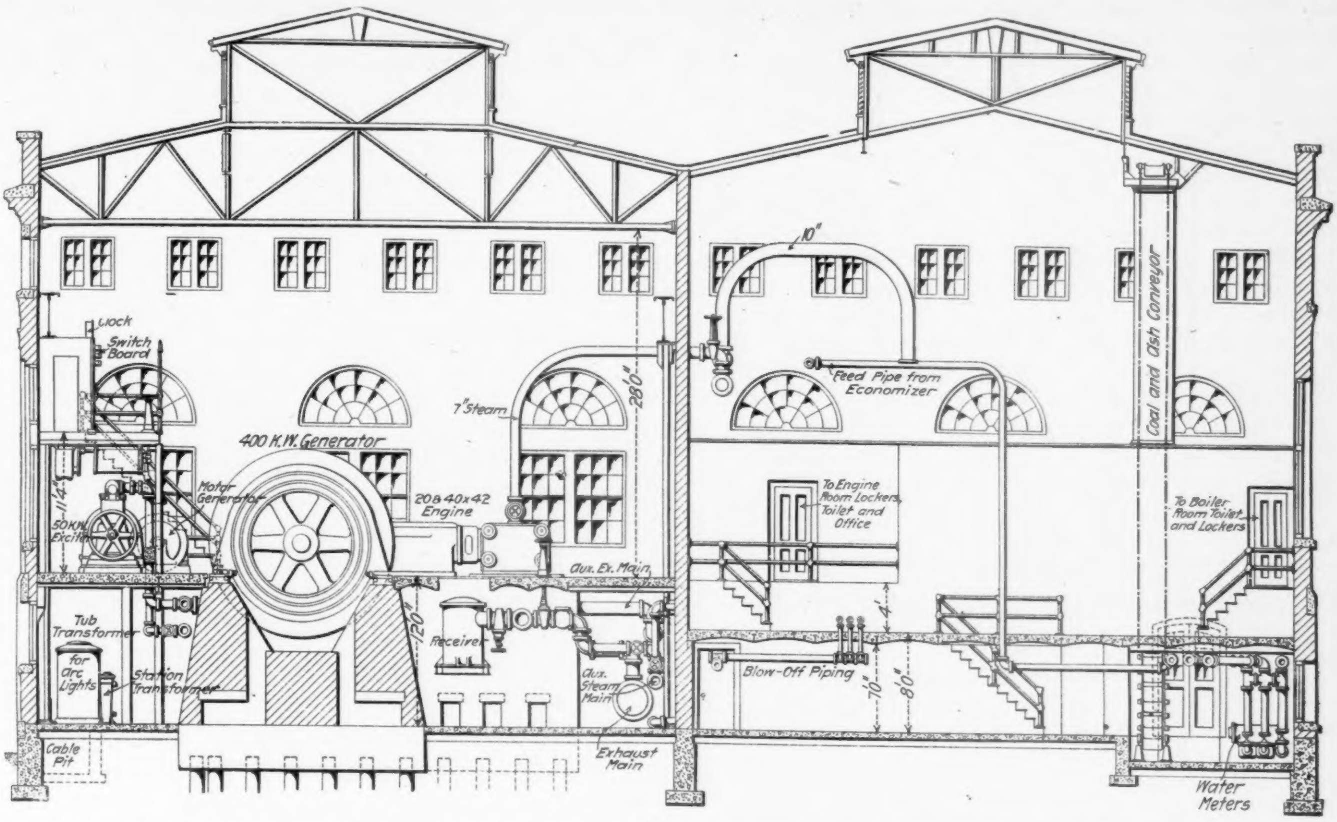
The blow-off tank, which is located in the basement immediately beneath the feed pumps, is a horizontal cylindrical tank, 4 ft. in diameter and 11 ft. long, with convex heads in one piece, the test pressure designed for being 200 lbs. per sq. in. Two inlets on the top receive the blow-off connections from the boilers, etc., while a third connection, of 6-in. pipe, leads from the top of the tank out through the roof to discharge the vapors of the hot blow-off to the atmosphere. The overflow connection, of 6-in. pipe leading to the sewer, is taken from the side of the tank so that the tank always remains about half full.

STEAM PIPING.

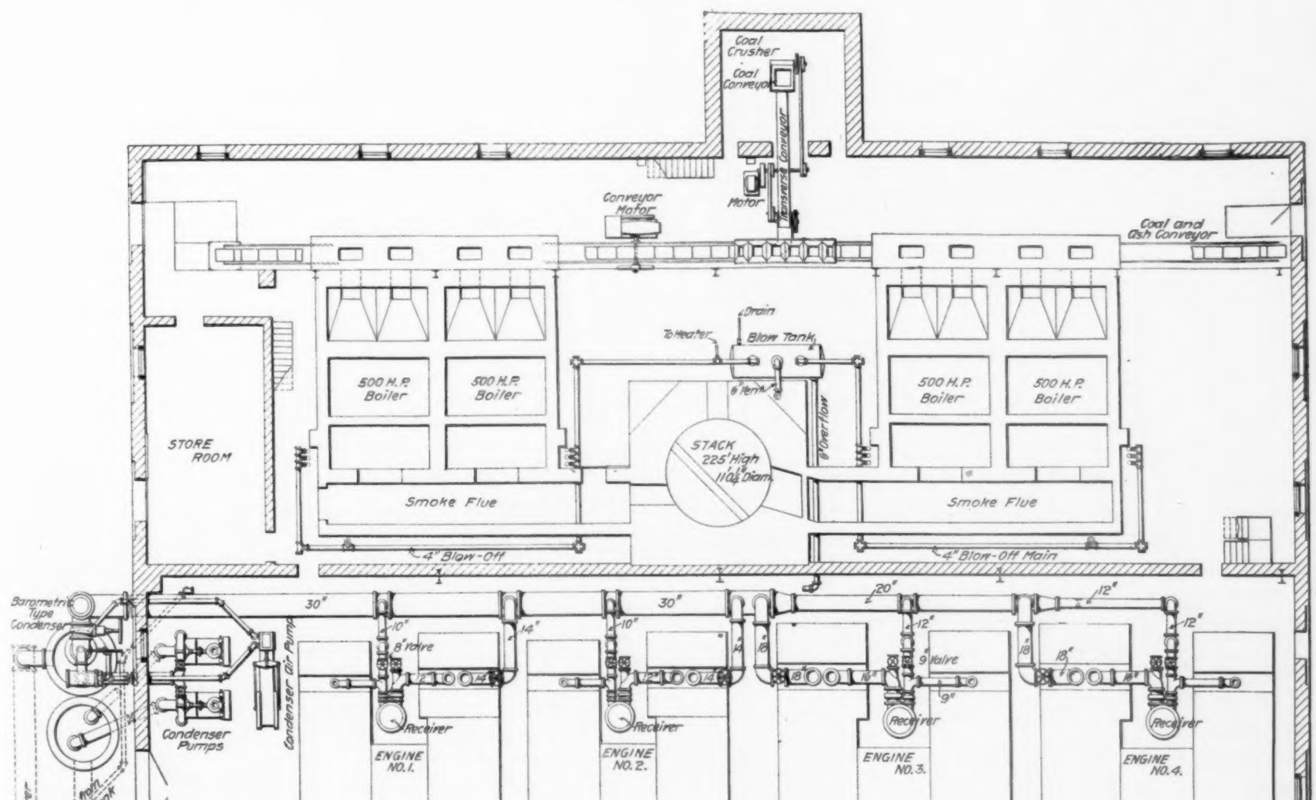
The arrangement of the main steam piping system is well shown in the plan and elevation views of the power house which were presented in the inset supplement to the preceeding issue. The system begins at the 10-in. automatic non-return, emergency and hand-stop valves on the manifold connections from the three superheaters of each boiler, and from these 10-in. pipes lead through easy bends to the 12-in. longitudinal steam header, on the boiler room side of the division wall, from which the delivery connections are made to the engines and to the auxiliary steam piping system. The entire system is laid out with great care to provide for expansion, by bends and angles. The pipe used is the "special full weight" grade of lap-welded, mild-steel pipe, and the entire system was tested throughout with the high pressure test of 400 lbs. hydrostatic for 48 hours continuously.

The interesting feature of this steam piping is the arrangement of the main header and the provision for expansion. As shown in the plan and cross section views in the inset, the steam header is carried on a pipe gallery at the rear of the economizer setting, at a height of 19 ft. 6 ins. above the boiler room floor; where the gallery is interrupted by the base of the stack, the header is carried around it by a loop with double-elbow vertical off-set connections at each end, which make excellent provision for expansion—this is best shown in section D-D in the inset. The header is arranged in sections, not on the loop system, but so as to permit individual connections between adjacent boilers and engines; the entire header is broken up by stop valves into four sections, each of which sections connects with one boiler and one engine. This is a very flexible and convenient arrangement of the piping system, as in this way the equipment may be sectionalized into four practically separate and individual power plants.

The gallery supports for the header are carried partly by the division wall and partly by rods from the roof trusses. The header rests upon two 6-in 12¼-lb. I-beams running along the outer edge, being fastened rigidly at the middle point of each portion of the gallery and allowed to expand in either direction. The provision for expansion at the intermediate points of support are shown in the detail of the roller bearing saddle, each of which permits of about 6 ins. of free and easy movement. The pipe saddle is arranged to move upon three pipe rollers, and these in turn roll upon a smooth plate clamped to the I-beam base; the three pipe rolls are held together by a novel side-



CROSS SECTION D-D THROUGH ENGINE ROOM, SHOWING ARRANGEMENT OF EXCITER UNITS, SWITCHBOARD GALLERY AND TRANSFORMER VAULT IN BASEMENT.—CROSS SECTION C-C THROUGH BOILER ROOM, SHOWING BLOW-OFF AND FEED PIPING.

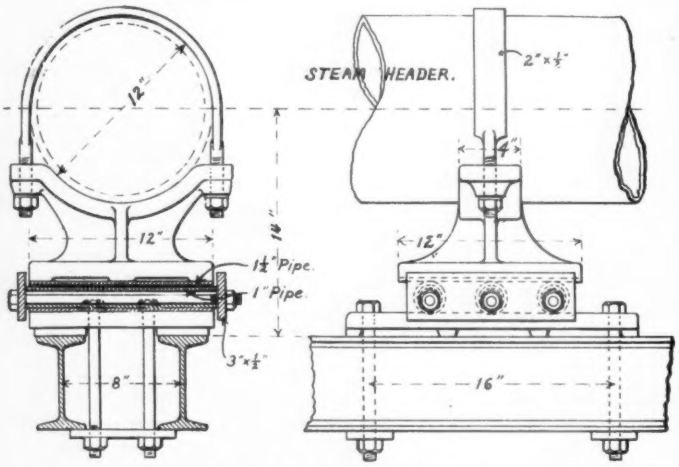


FOUNDATION PLAN OF THE BASEMENT, SHOWING EXHAUST PIPING AND CONDENSING SYSTEM, AND ALSO BLOW-OFF TANK AND PIPING.

plate distance piece arrangement, as shown, which keeps them in place relative to each other.

Each boiler connection has a 10-in. stop valve, not only at the boiler outlet, but also close to the header. The engine connections are each also provided with two valves, one the engine throttle and the other the angle valve just above the header. This is an important provision to protect idle boilers or engines in case of leaky valves. The outer ends of the header are closed with blank flanges. As will be noted, all connections are made to the header at the top side, there being no openings from the lower side except the drain connections. The connecting pipes are all arranged with long radius bends to provide for expansion; the sharpest bends are those of 4-ft. radius, which lead from each section of the header to the auxiliary steam header in the basement near the exhaust header.

Drainage is carefully provided for in the entire system of steam piping, as well as at the engines. Each section of the header has a "drop leg" of 12-in. pipe, with gauge glass, for condensation to collect in, which is connected to a steam trap for automatic drainage. The other steam pipes, including the auxiliary header, have at all points where water may collect drop legs, formed by tees opening downward and a section of the full size pipe extending down from it. In all cases the drop leg pockets extend down a distance of 24 ins. or more, in order to form a pocket of sufficient capacity to hold a considerable accumulation of condensation. Condensation is minimized throughout the entire plant, however, by non-conducting cover-



DETAILS OF THE ROLLER BEARING SADDLES USED TO PROVIDE FOR EXPANSION, IN SUPPORTING THE MAIN STEAM HEADER.

ings on all steam pipes, which are, in addition, re-covered with heavy canvas and painted.

An auxiliary system of steam piping is interestingly arranged to supply steam to the pumps, stoker engines, exciter engines in the engine room, and condenser pumps in the basement. This auxiliary header, which is of 6 and 8-in. pipe in sections, extends through the engine room basement at the rear of the large exhaust header, as shown in the accompanying cross-section D-D, and the basement plan. It consists of two long sections of 8-in. pipe, each fed from the main steam header by the above mentioned 4-ft. radius bends, and the two joined together at the middle by a long-radius bend of 6-in. pipe to provide for expansion.

The basement plan shows the details and arrangement of connections of this auxiliary header. There is a 4-in. branch leading from it to supply the pumps in the boiler room, and a 6-in. "ring" connection, or loop, extends across the engine room basement to supply the exciter engines and condenser pumps. There are also auxiliary connections to the low-pressure cylinder of each of the large engines, so that in case of starting or emergency, they can be operated from that cylinder. The auxiliary header is also divided into two sections by a stop valve, to provide against complete shut down in case of accident.

THE ENGINES.

The engine equipment consists of two 1,200-h.p. and two 650-h.p. compound condensing Corliss engines, direct-connected to 3-phase alternating-current generators of 750 and 400 kws. capacity, respectively. The engines are of the heavy duty cross-compound type, with receiver, and have the generators located between the cranks; they were built by the Westinghouse Machine Company, to the new and improved horizontal Corliss design recently perfected and introduced upon the market by them. They are designed to operate at a throttle steam pressure of 140 lbs., with 500 degs. F., total heat, and at an exhaust vacuum of 25 ins.

The engines are designed with particular care, in reference to the parallel operation of the generators; they all have similar characteristics of speed regulation, so that the power delivered is proportional to the load, and there is no tendency to periodic transfer, or surging, of the load from one engine to another. They are further guaranteed to not vary in speed in one revolution so much as to allow the generator, when delivering from no load to full load, to advance ahead or fall behind, a machine running at absolutely constant speed of the same number of revolutions per minute by more than .15 of 1 deg. The speed of any of the engines can be changed from the switchboard by an electric speed-changing attachment to the governor; this permits slight changes of speed while the engines are running, and thus facilitates the synchronizing of alternators or the changing of the load carried by any engine.

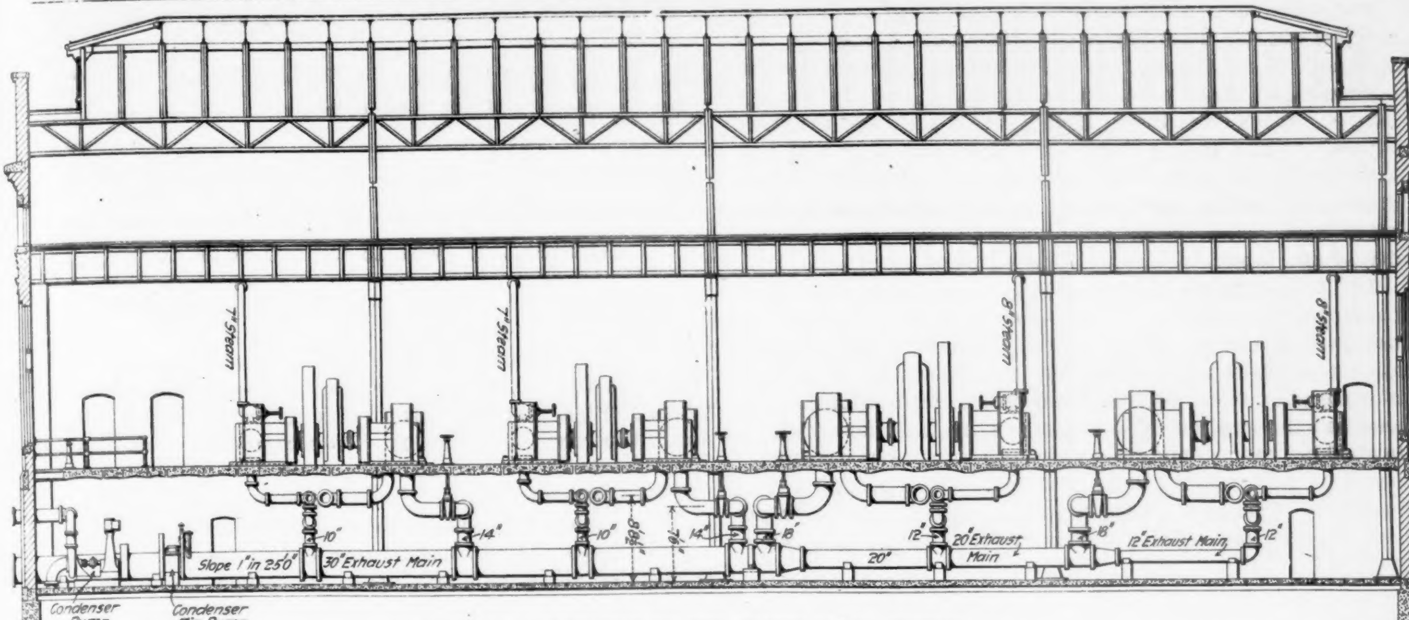
The important dimensions of the 1,200-h.p. engines are presented in the following table:

Diameter of high pressure cylinder	24 ins.
Diameter of low pressure cylinder	48 ins.
Length of stroke	48 ins.
Speed, normal full load	94 rev. per min.
Horsepower, indicated, normal	1,200 h.p.
Cut off, high pressure cylinder, normal	26 per cent.
Cut off, low pressure cylinder, normal	37 per cent.
Cut off, high pressure cylinder, maximum	75 per cent.
Diameter of crank shaft, center	21 ins.
Diameter of crank shaft, bearings	18 ins.
Diameters of piston rods, each	5 ins.
Face of crosshead gibs	22 ins. long by 11 ins. wide
Crosshead pins, length	9 ins.; diameter 8 ins.
Crank pins, length	9 ins.; diameter 9 ins.
Main bearings, length	36 ins.; diameter 18 ins.
Length of connecting rods, c. to c.	132 ins.
Diameter of connecting rods, at center	6 ins.
Diameter of flywheel	216 ins.
Width of face of flywheel	17 ins.
Weight of flywheel	60,000 lbs.
Thickness of piston, H. P. Cyl	12 ins.
Thickness of piston, L. P. Cyl	24 ins.
Diameter of main throttle valve	8 ins.
Diameter of main exhaust valve	18 ins.
Length of engine, over all	33 ft. 6 ins.
Width of engine, over all	27 ft.
Height of engine, over all	12 ft.
Total weight of engine, complete	280,000 lbs.

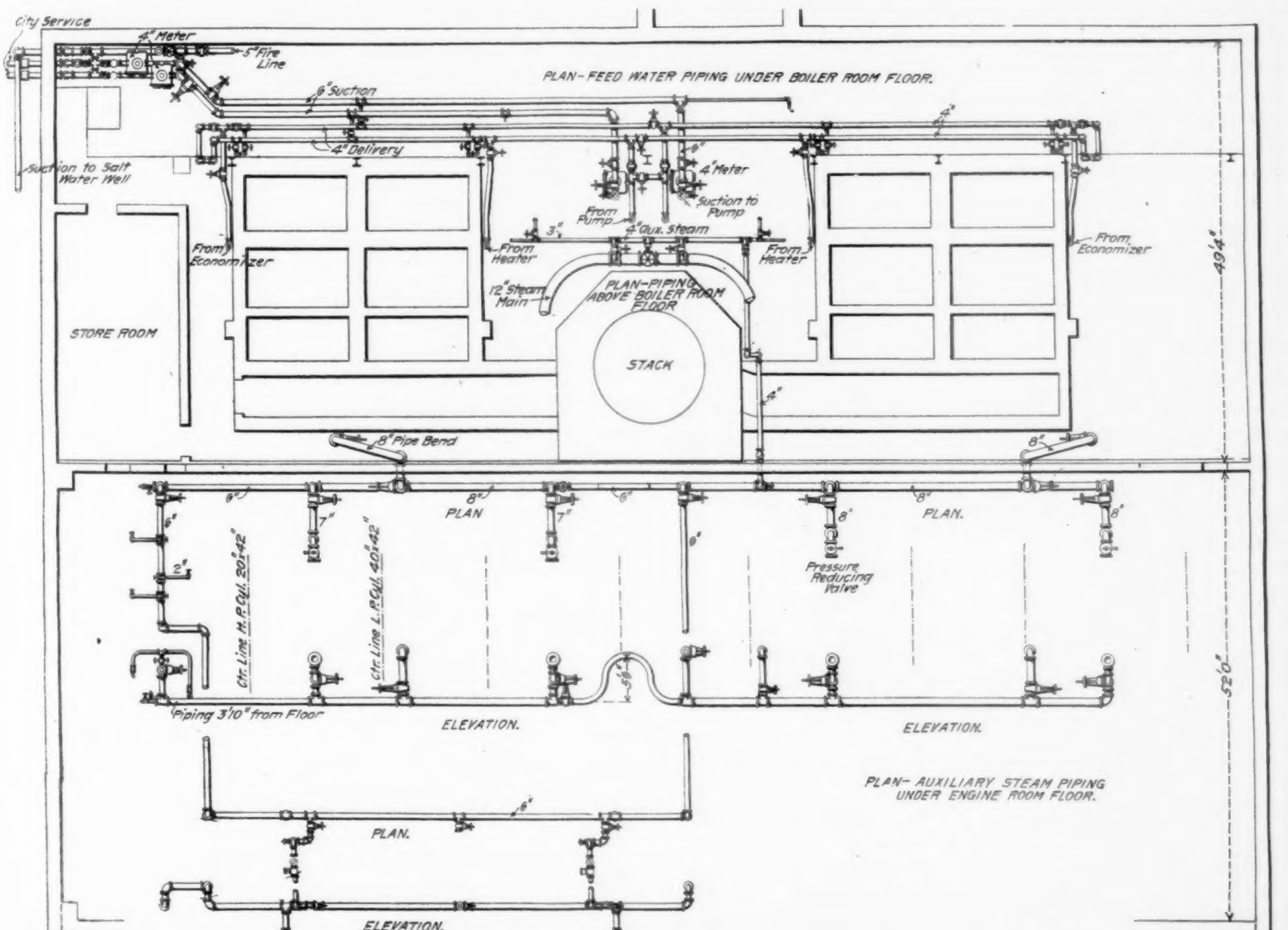
The principal dimensions of the 650-h.p. engines, which are of similar design, are also presented in the following table:

Diameter of high pressure cylinder	20 ins.
Diameter of low pressure cylinder	40 ins.
Length of stroke	42 ins.
Speed, normal full load	120 rev. per min.
Horse power, indicated, normal	648 h.p.
Diameter crank shaft, center	17 ins.
Diameter crank shaft, bearings	15 ins.
Diameters of piston rods, each	4½ ins.
Crosshead pins	length, 7¾ ins.; diameter, 6¼ ins.
Crank pins	length, 7¾ ins.; diameter, 7¾ ins.
Main bearings	length, 30 ins.; diameter, 15 ins.
Length of connecting rods, center to center	115½ ins.
Diameter of connecting rods at center	5 ins.
Diameter of fly-wheel	180 ins.
Width of face of fly-wheel	14 ins.
Weight of fly-wheel	40,000 lbs.
Thickness of piston, high-pressure cylinder	10 ins.
Thickness of piston, low-pressure cylinder	20 ins.
Diameter of main throttle-valve	7 ins.
Diameter of main exhaust-valve	14 ins.
Length of engine, over all	28 ft. 8 ins.
Width of engine, over all	21 ft.
Height of engine, over all	10 ft.
Total weight of engine, complete	195,000 lbs.

The governors of all the main engines are of the fly-ball type, and control the cut-off in both high and low pressure cylinders. They are of the safety type, so arranged that if any part fails or becomes disconnected, the steam is shut off so that destructive racing is not possible. The speed control effected is such that the speed variation does not exceed 2 per cent. for a 5-lb. change in steam pressure above or below normal, and 3 per cent. when full rated load is instantly thrown on or off. In addition to the safety feature of the governor the engines are equipped with safety stop regulators and stop valves, which are arranged to automatically shut off the steam supply in case



LONGITUDINAL ELEVATION OF THE ENGINE ROOM—SECTION A-A.



PLAN SHOWING BOILER FEED-WATER PIPING, AND AUXILIARY STEAM PIPING SYSTEM (PLAN AND PART ELEVATION) IN BASEMENTS.

the engine's speed increases more than 5 revolutions above normal.

The engines operating the exciters are 90-h.p. vertical cross-compound, non-condensing engines, and are of the standard type built by the Westinghouse Machine Company. Each of the two is direct-connected to a 50-kw. direct-current exciter dynamo, and operates at the same initial steam pressure and superheat as the larger engines. These engines are also carefully designed for the same speed regulation, the maximum variation between no load and full load being within 2½ per cent. The usual centrifugal type of shaft governor of the Westinghouse standard is used on these engines.

The important dimensions of these engines are presented in the following table:

Diameter of cylinders	High-pressure, 10 ins.; low-pressure, 18 ins.
Length of stroke	10 ins.
Speed, normal full load	320 rev. per min.
Horse-power, indicated, normal	90
Cut-off, normal	45 per cent.
Cut-off, maximum	85 per cent.
Diameter of crank-shaft, center	4¼ ins.
Diameter of crank-shaft, bearings	4¾ ins.
Wrist-pins	Length, 5 ins.; diameter, 2¼ ins.
Crank-pins	Length, 5 ins.; diameter, 4¼ ins.
Main bearings	Length, 12½ ins.; diameter, 4¾ ins.
Diameter of fly-wheel	52 ins.
Weight of fly-wheel	1,600 lbs.
Diameter of main throttle-valve	4 ins.
Diameter of main exhaust-valve	6 ins.
Floor space of engine	11 ft. 8 ins. x 4 ft. 6½ ins.
Total weight of engine, complete	16,500 lbs.

The design and construction of the engines of this plant are the best possible, according to our latest modern practice. The cylinders of all the engines are designed to permit two reborings, and their construction carefully provides for expansion and contraction. Metallic rod packings are used throughout and each cylinder is covered with magnesia non-conducting covering and lagged with polished sheet iron lagging, with polished corner strips. The cylinders are each provided with special water relief, or snifting, valves, and are drilled and tapped at each end for indicator connections.

The oiling system and its piping is very complete. Each engine has a complete automatic closed oiling system, in addition to the Michigan triple sight-feed lubricators, and 3-in. hand cylinder oil pumps upon each cylinder. The oil system consists of a complete set of drip pans and return pipes which collect and lead the used oil back through an oil filter and purifyer to a 150-gal. return tank, from which it is pumped by a steam oil pump to an elevated 150-gal. supply tank. From the latter tank a very complete piping system leads to the various sight feed oil reservoirs and to all other parts of each engine which require lubrication.

EXHAUST SYSTEM AND CONDENSERS.

The exhaust piping of this plant is divided into two systems, one of which takes care of the exhaust from the exciter engines, the condenser pumps, and the boiler feed pumps, and delivers it to the atmosphere through the feed water heater for heating feed water. The other system takes the exhaust from the main engines and delivers it to the condenser; this system is shown in the basement foundation plan, shown herewith. This main exhaust consists of two sections, one of 20-in. and the other of 30-in. cast iron pipe, and leads horizontally through the engine room basement to the condenser connection outside the south end of the building.

The condenser, which is of the barometric, central-jet type, is located outside the south end of the power house, elevated over the hot well, and is directly connected to a 30 x 20 x 20 x 24-in. cross in the exhaust pipe riser, on the top side of which cross is the 24-in. atmospheric relief valve, for creating an open air exhaust in case of failure of the condenser system. The condenser has two cast iron cones or condensing chambers, each flanged for a 20-in. exhaust connection, and it also has a 10-in. cold water injection connection. A dry air connection is provided and a 10-in. tail pipe extends down from the condenser chamber to the hot well.

The circulating water for the condenser injection is furnished by two steam-driven centrifugal pumps in the basement, which take their suction through special strainers and foot valves from an intake well receiving water from the Hudson River. The suction connections are 12-in. and the delivery 10-in. pipe, which lead to the injection nozzle of the condenser. A dry vacuum pump is also provided to remove accumulated air from beneath the condensing cones and thus prevent breaking the vacuum.

The capacity of this condensing outfit is such as to be able to take care of a total of 55,000 lbs. of exhaust steam and maintain vacuum, when the generators are running at full rated load. The combined capacity of the circulating pumps is sufficient for condensing all the steam at 150 per cent. of the rated load. The vacuum at the various loads for which the condensing system is designed is guaranteed as follows: Three-quarter load, 27 ins.; full load, 26 ins.; 50 per cent. overload, 25 ins. The overflow and all other piping is carefully arranged to prevent flooding the steam cylinders in any case.

ENGINE ROOM CRANE.

The engine room is provided with a 20-ton single-trolley traveling crane, of 50-ft. span, which was furnished by the Alfred Box Company, Philadelphia, Pa. The bridge, trolley and hoist movements are all operated by hand power from a suspended platform from the bridge. The bridge girders are of plate girder construction and so designed that no portion receives a maximum stress of over 12,000 lbs. per sq. in. of section under full load. The principal dimensions of this crane are given below:

Span, center to center of bridge truck wheels	50 ft.
Wheel base of bridge truck wheels	9 ft.
Distance, center to center of bridge girders	5 ft.
Maximum lift	30 ft.
Wheel base of trolley	4½ ft.
Diameter of hoist-rope	⅝ in.
Capacity of crane	20 tons

COMMERCIAL VALUE OF ECONOMIZERS.

In a paper read before the Philadelphia Foundrymen's Association, Mr. A. H. Blackburn said:

"From our records we find that the average life of a well built economizer is from 15 to 20 years, with ordinary care and attention, and therefore it is a conservative basis to allow a 6 per cent. depreciation. From records of a number of large plants the cost of maintenance and repairs has not exceeded 1 per cent., but to be on the safe side allow 2 per cent.

"The value of an economizer varies in proportion to the cost of fuel and the heating value of that fuel, and the cost of installation varies according to the designs and conditions of each particular plant. Taking the average manufacturing plant, and estimating saving of 10 per cent. in the total fuel consumed during the year, working 300 days during the year and ten hours per day, the economizer will show the following gross return on the investment:

	Per cent.
With coal at $5.00 a net ton	48.1
With coal at 4.00 a net ton	38.5
With coal at 3.50 a net ton	33.7
With coal at 3.00 a net ton	28.9
With coal at 2.50 a net ton	24.
With coal at 2.00 a net ton	19.2

"Subtracting from this gross return per annum on the investment the cost of depreciation, maintenance and repairs, with coal at a cost of $2 per ton delivered in the boiler house, the economizer pays a good return on the investment. If a plant works 20 hours out of the 24, as a number of manufacturing plants do, the return doubles up. This estimate only takes into consideration the saving of fuel, to which should justly be added the gain from the other advantages mentioned in the first part of this paper.

"In the above estimate I have only considered the average boiler plant, taking a conservative estimate of 10 per cent. saving, but where hot furnace and other gases are available a much larger saving is being made."

MACHINERY ORDERS FOR RAILROAD SHOPS.

Further purchases of fair sized lots of machine tools by some of the railroad companies have served to make more apparent the improvement in the machinery trade, which has become noticeable during the last few weeks. These orders, coupled with the smaller bookings, make up a fair week's business. Conditions generally are brightening, and throughout Liberty street a more confident feeling prevails toward the near future. The next week, it is said, will bring forth some good contracts, among which is mentioned an important lot of machine tools aggregating more than $50,000 in value.

The Delaware & Hudson Railroad Company have placed an order with the Niles-Bement-Pond Company, New York, for about $60,000 worth of machine tools for their shops at Green Island, N. Y. This order was placed against the list which they issued some time ago, calling for upward of $75,000 worth of tools for their shops, including those at Oneonta, N. Y., and Carbondale, Pa., so that, while the company may not contemplate buying further at present, there is probably some $10,000 or $15,000 worth of tools yet to be purchased.

The Southern Pacific Railroad Company have closed for a fair sized lot of tools for installation at Reno, Nev., where they have recently completed the erection of new shops. The transaction has aroused considerable interest in Liberty street, where it is rumored that the entire order was placed with Manning, Maxwell & Moore.

These orders with many others for other than railroad companies are recorded in the *Iron Age* in connection with the general machinery market.

THE APPLICATION OF INDIVIDUAL MOTOR-DRIVES TO OLD MACHINE TOOLS.

McKEES ROCKS SHOPS.—PITTSBURGH AND LAKE ERIE RAILROAD.

BY R. V. WRIGHT, MECHANICAL ENGINEER.

IX.

THE 72-INCH WHEEL LATHE.

In this article the discussion of the motor equipments for lathes at the McKees Rocks shops will be concluded by a description of the motor-driving application to the 72-inch Niles driving wheel lathe which had been used at the old shops. The engravings, Figs. 44 and 45, illustrate this old lathe as thus equipped with the Crocker-Wheeler multiple-voltage system for variable speed driving. This drive involves the important point of difference from the other drives previously discussed in this series, in that here a back-geared type of motor is used.

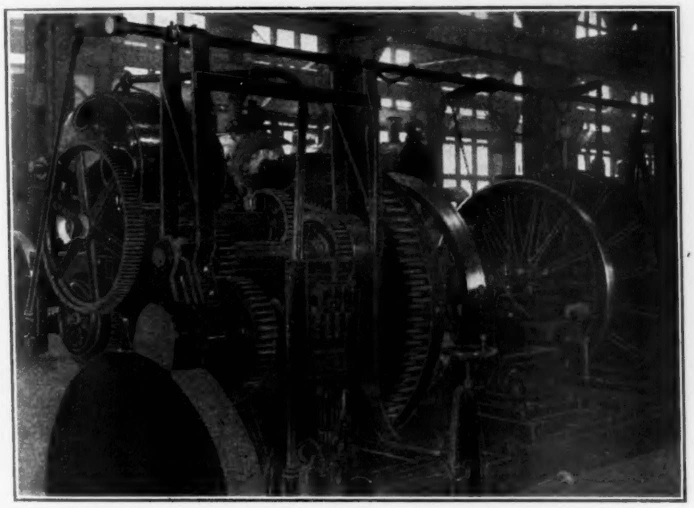


FIG. 44.—VIEW OF THE WHEEL LATHE AT THE MCKEES ROCKS SHOPS, AS CHANGED FOR THE INDIVIDUAL DRIVE.

develops 25 h.p. at 240 volts, is used to drive this tool, in connection with a type 80-M. F.-21 controller, for obtaining the variable speeds available with the multiple-voltage system.

Referring to Fig. 45 it will be noted that the controller is placed on its side, on the floor, and that it is operated through a long extension shaft which is coupled to it and can be turned from either one of two handles. The extension shaft is carried underneath the projecting part of the bed casting and is entirely out of the way of the operator. One controller handle is placed near each face plate, as shown in view; this arrangement is very convenient when hard spots appear on one of the tires and it is necessary for the operator to slow up or stop, as a handle is always within easy reaching distance. The vertical castiron brackets, each of which supports the extension shaft and carries a vertical shaft upon which is the hand wheel, is fastened to the floor by means of lag screws and is designed with a view to stiffness. It is similar in general design to the vertical controller hand-wheel bracket which was used upon the large Niles lathe and described in Article IV of this series (see page 410, of Nov. 1903).

The arrangement of the step pulley, gearing, etc., for the drive, as used when the tool was belt driven, is shown by one of the diagrams in Fig. 46; when it was desired to true up journals, the lock plate, which was feathered to the shaft upon which the speed cone runs, was locked to the cone and gear 5 was moved over out of mesh with gear 6, so that the face plate was driven through gears 7 and 8. When tires or wheel centres were turned, the lock plate at the end of the cone was unlatched and gear 5 was thrown in mesh with gear 6, thus allowing the face plate to be driven by gears 1-2x3=4x5-6.

The other diagram in Fig 46 shows the arrangement of gearing that was designed for the motor drive. The plate which was used for locking the speed cone to the shaft with the belt drive was retained, and a sleeve was designed to replace the cone and to carry gears D and E; the sleeve was designed so that the lock plate could be locked to it at will. In order to keep the proper ratio between the two runs of gearing with the motor drive it was necessary to replace gears 1 and 2 by the new gears E and F.

The reduction of speed from the motor to the sleeve which replaced the belt cone was so great, the power to be trans-

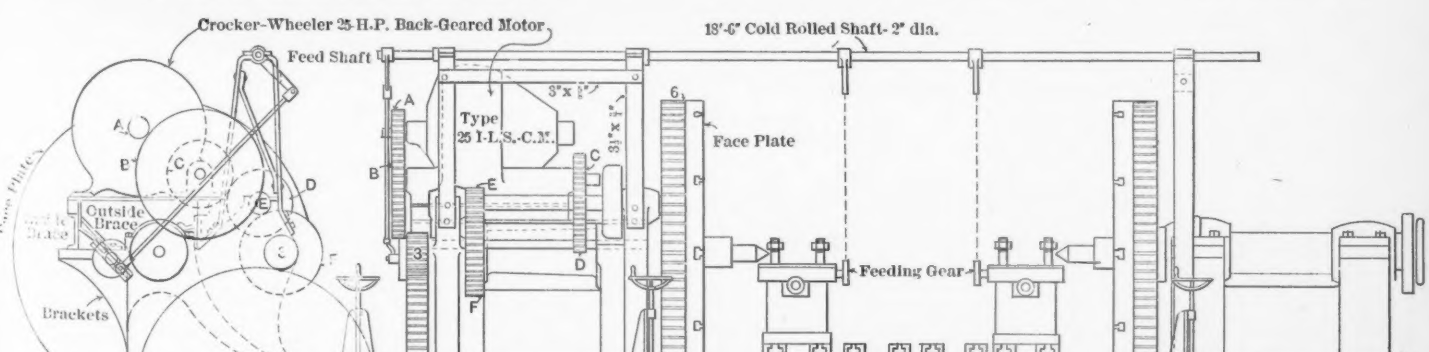


FIG. 45.—DETAILS OF APPLICATION OF INDIVIDUAL MOTOR-DRIVING TO THE 72-INCH NILES DRIVING WHEEL LATHE.—CROCKER-WHEELER MULTIPLE-VOLTAGE SYSTEM.

The motor, as applied in this case, is carried upon a ¾-inch steel plate bed, which is supported by two long castiron blocks resting upon two 8-inch channel irons, as shown in the end view. The rear channel rests upon two brackets which are part of the frame of the tool and which formerly carried the quartering attachment—this attachment was done away with as it had been found desirable to confine this work to a special tool provided for the purpose. The channels which support the motor are well braced by wrought-iron straps, as shown. A Crocker-Wheeler type 25I. L.S. C.M. motor, which mitted was so heavy and the diameter of the large chain sprocket was so limited by the shape of the frame of the tool, that a silent chain to make the necessary reduction would have to be of a comparatively small pitch and be very wide. It was found that by introducing another shaft between the motor and the sleeve, or rather by using a back-geared motor, the reduction could be made by gearing at considerably less expense than by the use of a silent chain, and this was done, as shown.

The shaft which carried the arms for operating the feed

mechanism was formerly supported by hangers, fastened to the roof trusses of the shop building; it is now attached to the tool frame by means of wrought-iron braces, as shown. On account of the increased distance necessary between bearings it was necessary to provide a heavier shaft than was used before. This shaft is less than eight feet from the floor and is placed far enough in front of the centre of the face plates so as not to interfere with placing the wheels in the tool with the traveling crane. The reciprocating motion is transmitted to the feed shaft from a gear which meshes with another gear on the end of the main spindle; a rod of ¾-inch pipe with a special casting on each end, is eccentrically pivoted to this gear and thus causes the feed shaft to rock by means of the lever at the end.

An interesting study is afforded by use of the diagram

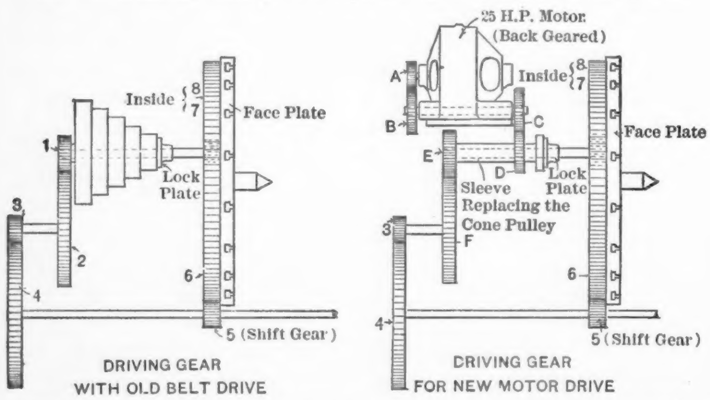


FIG. 46.—DIAGRAMS OF THE OLD AND NEW ARRANGEMENTS OF THE GEARING IN THE DRIVE OF THE NILES DRIVING WHEEL LATHE, SHOWING CHANGES NECESSARY FOR THE MOTOR DRIVE.

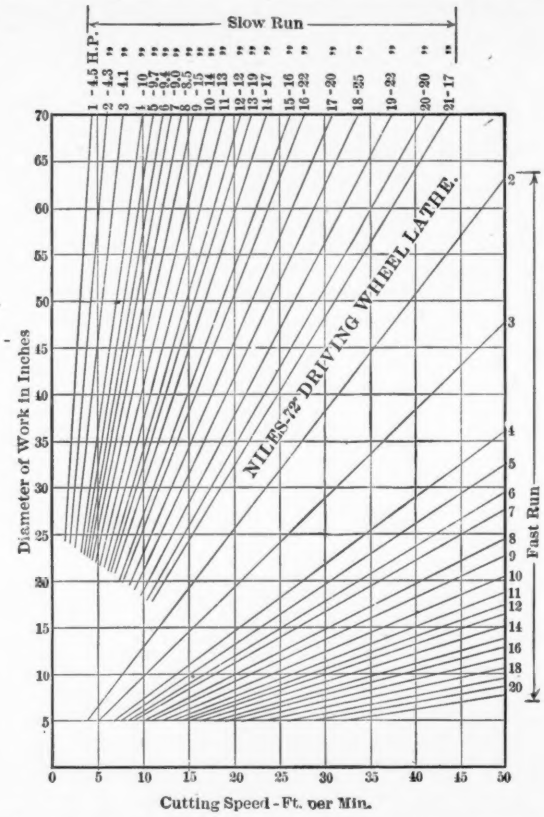


FIG. 47.—SPECIAL CUTTING SPEED DIAGRAM—NILES WHEEL LATHE. THIS SHOWS THE CONTROLLER POINT WHICH WILL DRIVE WORK OF ANY DIAMETER AT ANY DESIRED CUTTING SPEED.

shown in Fig. 47; the point at which the controller handle should be set for any cutting speed, on a given diameter within the limits of the tool, can readily be found from it. The horsepower which the motor is capable of exerting, at the different points without overloading, is also shown.

Between 80 and 90 per cent of the locomotives on the Pittsburgh and Lake Erie are equipped with 44-inch wheel centres and the diameters of the greater portion of the tires that will be turned will therefore vary from about 7-ins. to 51-ins. in diameter, depending on how much they are worn. With high-speed tool steels the tires should be turned at from 18 to 25 feet per minute.

The motor was applied so that its maximum power should be available when tires of about 50 ins. in diameter are turned at a cutting speed of 25 feet per minute. For instance, it will be noted by referring to Fig. 47 and following the diagonal which passes nearest to the intersection of the abscissa from 50-ins. diameter and the ordinate from 25-ft. cutting speed that the controller should be set on point 18 and that at this point the motor develops its full rated power, namely 25 h.p.

EDITORIAL CORRESPONDENCE.

IMPRESSIONS OF FOREIGN RAILROAD PRACTICE.

(*Continued from Page* 85.)

GLASGOW, December 12, 1903.

At a particularly busy junction near London 1,200 trains pass daily. If locomotives operating past this point are not kept in the pink of condition, such service would be impossible. This matter of maintaining locomotives in England has so deeply impressed the writer that he may be excused for repetition in commenting upon it. Naturally one tries to secure figures for comparison, but this is difficult. It seems to be the general rule for managers to expect perfect locomotive service and every breakdown or failure of any kind to make time is carefully gone into and equally carefully reported upon always to the manager and generally to the directors. At the bottom of this remarkable service lies the fact that if the locomotive superintendent is not sufficiently supplied with engines, so that he can be sure of plenty of time for work upon them at terminals, he at once supplies the deficiency and is given plenty of authority to do so. He builds engines when he needs them.

The perfection of painting and attractive appearance of locomotives is found in England. This must strike the observer as being carried too far. In fact the time and labor cost is great and we could not hold engines from 10 to 14 days in a specially provided locomotive paint shop, yet it will not do to brush aside this practice as entirely foolish and extravagant. It may be carried to an extreme and care in design, which leaves no corners in which dirt may collect, may cost something in the drafting room and in the shop, but the conclusion is unavoidable that these matters exert an important influence in the performance of the engines. One thing is positively certain—English railroad men know how to get the best work out of a locomotive and they also know how to keep it in condition for doing so. In this they are far ahead of the continental railroad men, and they are far and away ahead of us. The engines are kept up even if the stockholders wait a little for some of their dividends. One locomotive superintendent told the astonishing story of only four engine failures in the month of November last. He included all delays of 2 minutes and over which could be chargeable in any way to the locomotive. He was asked to repeat the statement and did so, showing that he fully understood the question. This road operates 830 locomotives. This officer says that it does not cost him anything to keep up his engines because delays would incur very heavy expense.

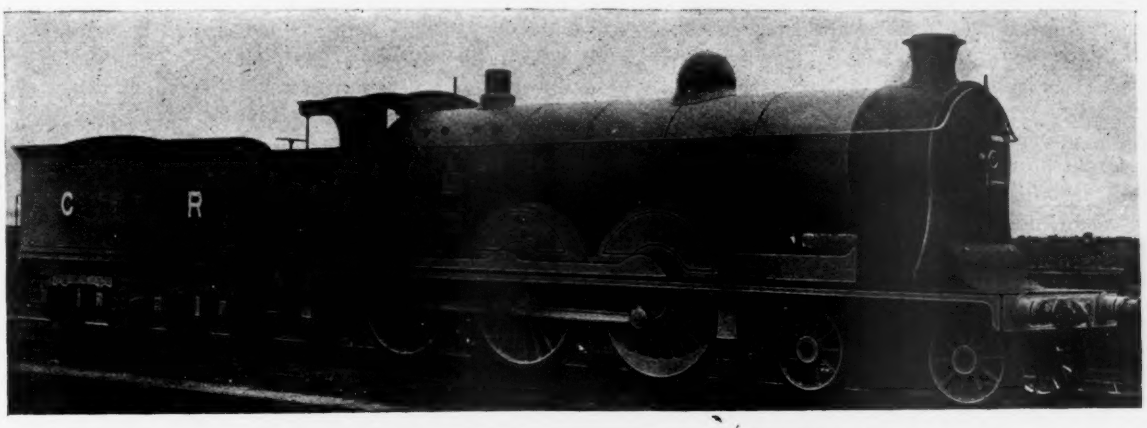
A parliamentary regulation which is rather carefully enforced by the board of trade limits the working day of enginemen to 10 hours. All cases of overtime must be officially reported, and this tends to keep them down to the lowest possible limits. Some of the most progressive men are introducing "double crewing," but there is little of it done and it is proper to say that the locomotives generally rest when the men rest which allows from 10 to 12 hours for any necessary work. Even the engines making the largest mileage are in the "running sheds" at least four hours daily. As there is very

little trouble with flues, this gives time for everything needing looking after.

The "lick and promise" repairs of the American roundhouse are unknown here. Punctuality and economy being required of the engineers, the roads cannot in fairness neglect anything which will tend to help the men to make records. English officials regard pooling with "holy horror" and plainly say so. They cannot understand how we do it, and characterize it as *impossible*. These people do not send a locomotive out to take its train when half the working parts are gone. It is to be regretted that American managers do not come over here and see what an important thing it is to maintain locomotives. With the Englishman this is not sentiment at all, but pure business and it would be worth while for an American road to try the policy to learn whether or not it pays.

Attempts to get figures for mileage per engine failure were not generally successful because few locomotive superintendents could give me the figures and only one of those who gave them was willing to have them printed.

comparisons to be made between their work and that of their neighbors. Figures are usually given in pounds of coal per mile. The methods of keeping the records, however, do not admit of making positive statements with confidence. People over here are not yet educated to the importance of the ton mile as a unit of measurement, and a very well known locomotive superintendent spoke sneeringly of this unit, saying that he took no stock in it whatever. The real reason is that the light loads of freight trains would make no showing at all in tons. Again, when freight service is habitually conducted at speeds of 35 and 40 miles per hour to keep it out of the way of a large number of fast express trains, the speed, as well as the tonnage, becomes an important item. The statement that the most progressive locomotive superintendent in England is cherishing the hope of eventually hauling 1,000 ton trains on a road which is positively a "billiard table grade" all the way, is perhaps enough to say of the freight service. It is interesting to be told that engines capable of hauling 1,000 ton trains are too heavy for present bridge construction and



NEW SIX COUPLED PASSENGER LOCOMOTIVE.—CALEDONIAN RAILWAY.

Most (but not all) of these officials are very "canny" about giving figures concerning their practice. They make a serious mistake in thinking that they ought to conceal their work and methods from their competitors.

I may say that I did not see a single passenger engine hauling its train with any leakage of steam about the valve or piston rods.

Flue troubles, such as we have, appear to be unknown here. The water is not very much better than ours, but of course, the work done is very much lighter. That done by the largest passenger engines, however, is sufficient to start the flues, if it were not prevented. Brick arches in the fireboxes are the rule here and they are very carefully kept in condition. Another good device in the firebox is a deflector over the door which, besides contributing to economy of fuel consumption and reduction of smoke, serves to prevent cold air from striking the tube ends when the firedoor is opened. This deflector sometimes is the door itself, opening inwardly and directing the incoming air down upon the fire, or it may be an inverted trough of sheet steel, secured over the door, and reaching perhaps about two feet into the firebox. In either case the air is prevented from passing directly against the tube ends.

On many of the roads the firebox ends of the flues are not bent over at all and on others, as previously mentioned, only the lower rows are so treated. In all cases the tubes are well expanded and taper ferrules are driven into the ends of the tubes, *inside* the ends, with the end of the ferrule left projecting far enough from the end of the tube toward the fire, to protect the tube itself from the intense heat. The tube sheets are always of copper, the tubes sometimes of brass and sometimes of steel and the ferrules are of steel.

Comparisons of the performance of locomotives of two countries are difficult to draw, especially when the people, either do not know exactly what their engines are doing or do not wish also that in at least one case the largest passenger engine which is a fine new design must be disconnected from the tender in order to turn it at the terminals. This appears to be small scale railroading, but nevertheless it is surprising to know what a ton of coal will do here in these small engines.

On the Caledonian Railway, Mr. McIntosh has built two beautiful 4 6-0 passenger engines. These are certainly among the most powerful passenger locomotives in Great Britain. Because of the work they are doing the leading dimensions are presented in the accompanying table:

CALEDONIAN RAILWAY 4—6—0 PASSENGER LOCOMOTIVE.

Weight on drivers	123,440 lbs.
Weight, total, of engine	163,400 lbs.
Cylinders	21 by 26 ins.
Driving wheels, diameter	78 ins.
Boiler, center from rail	8 ft. 6 ins.
Boiler, length of barrel	17 ft. 4½ ins.
Boiler, outside diameter	60 ins.
Firebox, length	102 by 48 ins.
Firebox, depth from center of boiler, front	63 ins.
Firebox, depth from center of boiler, back	45 ins.
Tubes, number	270
Tubes, length	17 ft. 3 ins.
Tubes, diameter, 257	1¾ ins.
" " 13	2½ ins.
Heating surface, tubes	2,255 sq. ft.
Heating surface, firebox	145 sq. ft.
Heating surface, total	2,400 sq. ft.
Grate area	26 sq. ft.
Boiler pressure	200 lbs.
Tractive force	22,050 lbs.
Tender tank capacity	5,000 gals.

This engine is interesting also, because Mr. McIntosh considers it the limit in the matter of size and capacity, in the simple engine and is of the opinion that the next step for consideration is the four-cylinder compound. He is favorably impressed with the De Glehn locomotives and he gave the impression that he would look to that type for further developments. This "50 Class," of which dimensions are given, is quite new and is considered experimental. Indicator cards have been taken, but at the time of the writer's visit, they had not been worked up and no figures of indicated horsepower were avail-

able. These engines are hauling the heaviest passenger trains between Glasgow and Carlisle in the West Coast service, connecting with the London & Northwestern for London. One of these trains leaves Glasgow at 10.45 p. m., arriving at Carlisle at 12.55 a. m.—102 miles in 130 minutes or a little better than 47 miles per hour. In this distance for 52 miles there is an average rise of 20 ft. per mile. With a train of 380 tons, back of the tender this is a good run, but the surprising thing about it is the statement that it is never necessary to burn over three tons of coal on this run and that it is sometimes made on two and a half tons. This is Scotch coal, which is not as good as the Welsh coal, generally used in England. The exact coal performance could not be verified for several reasons, but figures will be obtained if possible, as it is important to know positively the terms under which these engines are working. The engineer running one of these engines stated to the writer that he could always count on 200 lbs. of steam in the boiler. This is certainly good work for an engine having 2,400 sq. ft. of heating surface and weighing 163,000 lbs. It is more than questionable whether one of our engines of equal weight and heating surface would do this work on such a small coal consumption and whether the steam pressure would stand at 200 lbs. all the way.

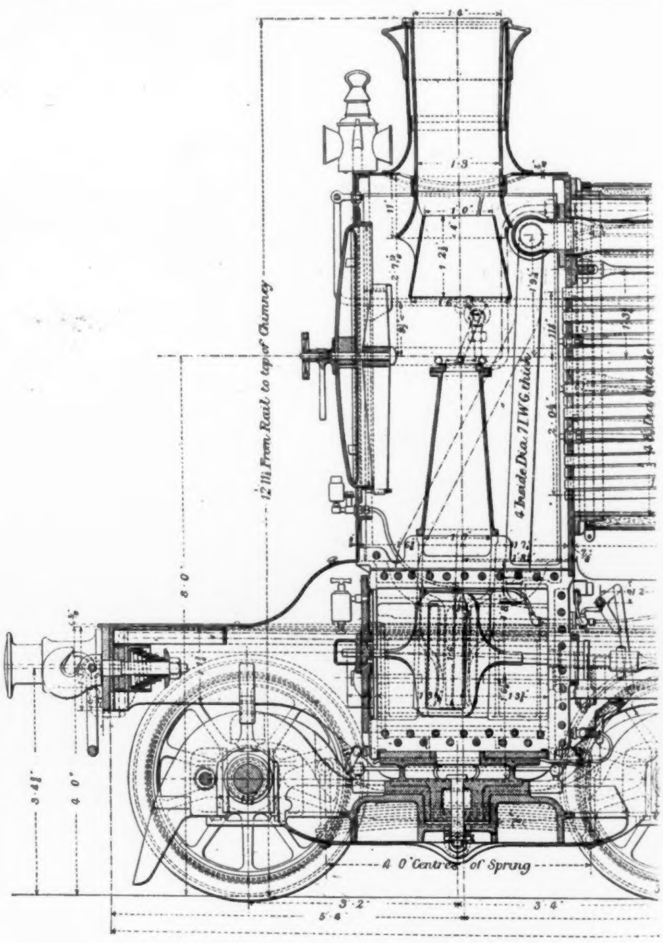
These engines with 21 by 26 in. cylinders are now running with single nozzles 5¾ in. in diameter. They have no netting or deflectors in the smoke boxes and absolutely nothing to obstruct the egress of the exhaust and the waste gases. The nozzle is high, terminating about 3 in. below the center of the boiler and, the cylinders being inside connected, the exhaust passages are direct and short. The stack is extended down into the smoke box and below its flaring base is a short petticoat pipe. While the front end is absolutely open for the passage of sparks, comparatively few are thrown when at speed. In studying the drawings for reasons for the excellent steaming qualities, it was found that Mr. McIntosh had done most careful work in adjusting the exhaust nozzle and the petticoat pipe and also in placing the brick arch in the firebox at exactly the right height. He is a firm believer in bringing the front end and firebox to an exact "focus," and finds it most important to secure the correct relations between the nozzle and the stack. He believes the firebox to be the place in which to burn the fire and aims to keep the sparks on the fire. The firedoor opens inwardly and directs the incoming air downward toward the fire. The grates slope sharply toward the front and the lower line of the brick arch at the center, when prolonged on the drawing, hits the top edge of the firedoor opening. This is done with a view of preventing the passing of cold air from the door, directly into the tubes. It is worth remarking that no smoke boxes are to be seen which have any indications of ever having been hot. The paint upon them and on the boiler fronts seem to be, almost universally, in good condition. This is surprising in view of the small heating surfaces.

Mr. McIntosh makes a practice of cambering all tubes used in his locomotives. They are bent uniformly throughout their length, the center of the tube being offset from the center line through the ends by an amount equal to the diameter of the tubes. This is done in order to relieve the tube sheets from the stresses which straight tubes subject them to in expanding and contracting. The cambering gives them an opportunity to bend still more, or to straighten out to meet the stresses of expanding and contracting. The cambering is done by a laborer who merely passes the tubes through a hole in a large block of wood and bends them slightly by putting his weight upon the free end. By a little practice he gives the tube an easy and smooth curve without jamming or flattening it. This appears to be well worth trying and it is perfectly easy to do.

Tube sheets (the rear ones) here are almost invariably of copper and quite thick. Some were noted on the London & Northwestern which were one inch thick. It is usually the tube sheets which fail first and this necessitates renewing the tubes. It is clear to the writer that the use of the brick arch is very beneficial to fireboxes here, particularly because great care is taken to deflect the cold air from the firedoor, so that it will pass down onto the fire or under the arch and not pass directly against the ends of the tubes and the tube sheet. Deflecting firedoors appear to represent an important principle in this respect.

Mr. McIntosh does not believe in pooling engines and in answer to a question as to the number of his engine failures causing delays of 2 minutes or more, he replied that he always received a letter or telegram from the general manager whenever such a delay occurred. This indicates that he does not have many. He believes that a clean engine will be well cared for and that it pays to be most careful in this and in the running repairs. He insists on having certain men to inspect engines and others to repair them, which seems rather important.

Reverting to the matter of adjusting the "front ends" of locomotives, it should be stated that Mr. McIntosh does this work very carefully in the case of every new engine and then by the use of templets and gauges others of the same class are put in correct order in the shop, and require no subsequent

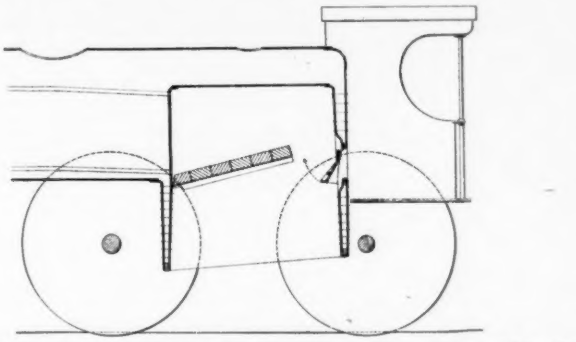


A TYPICAL BRITISH SMOKE BOX ARRANGEMENT.

adjustment. When the right position of the petticoat pipe is found a pattern is made and the engines of that class are fitted with petticoats which are integral with the cast-iron liner of the stacks, and no adjustment whatever is provided in that member. The best talent of the department is devoted to the drafting of locomotives, and it is done once for all for each class. There is no tinkering with front ends here.

It will be difficult to convey a correct impression of the attention given to "drafting" British locomotives. The adjustment of the nozzle and petticoat is considered vital to the proper operation of the engine, and to the care devoted to this I attribute in a large degree, the good steaming qualities of engines which we consider very deficient in heating surface. The firebox conditions also help and these will be referred to again. As the new ten-wheel Caledonian engine is still considered as in the experimental stage, it cannot be illustrated in detail now, but the arrangement of a similar "front end" of the latest 4-4-0 class serves to show the nozzle, stack and cast iron petticoat. This petticoat when finally decided upon is not

adjustable. As seen in the engraving (reproduced from *Engineering*) there is no diaphragm plate and no netting. There is something occult in the adjustment of the exhaust nozzles on this road for high speed engines, and I suspect that the nozzles are not exactly vertical. The axis of the nozzle is



A TYPICAL BRITISH BRICK ARCH AND FIRE DOOR. THESE ARE ADJUSTED AS CAREFULLY AS THE "FRONT ENDS."

inclined forward, but only a little. Whether there is anything in it I cannot say, but the fact remains that the last adjustment of the new ten-wheel engine which resulted in fine steaming, consisted in a slight tipping of the nozzle. This fact, at least, serves to indicate how carefully the drafting is done, and that is the important fact to be brought out. These parts receive that is the important fact to be brought out. The brick arch receives as careful attention as the drafting, and these little engines steam well without tearing their boilers all to pieces.

An exceedingly important feature of British locomotive practice is the fact that the appearance of a new design is considered an epoch-making event in the department. It is prepared for perhaps two years in advance. The study put upon the drawings is something unknown with us, and the engine is built after every detail has been most carefully studied in the light of what has gone before. The best talent of the department is concentrated for many months upon each new design. This is expensive, but I believe that it pays large interest on the investment.

In passing through the shops at Glasgow attention was arrested by a row of seven boilers, ready, with fittings complete and laid in a convenient place, for use on the standard engines. In case a boiler of a road locomotive needs heavy repairs, and the rest of the engine is in good condition, one of these is used and the engine returned to service within a few days. Its own boiler is then made ready for use on the next occasion of the kind.

G. M. B.

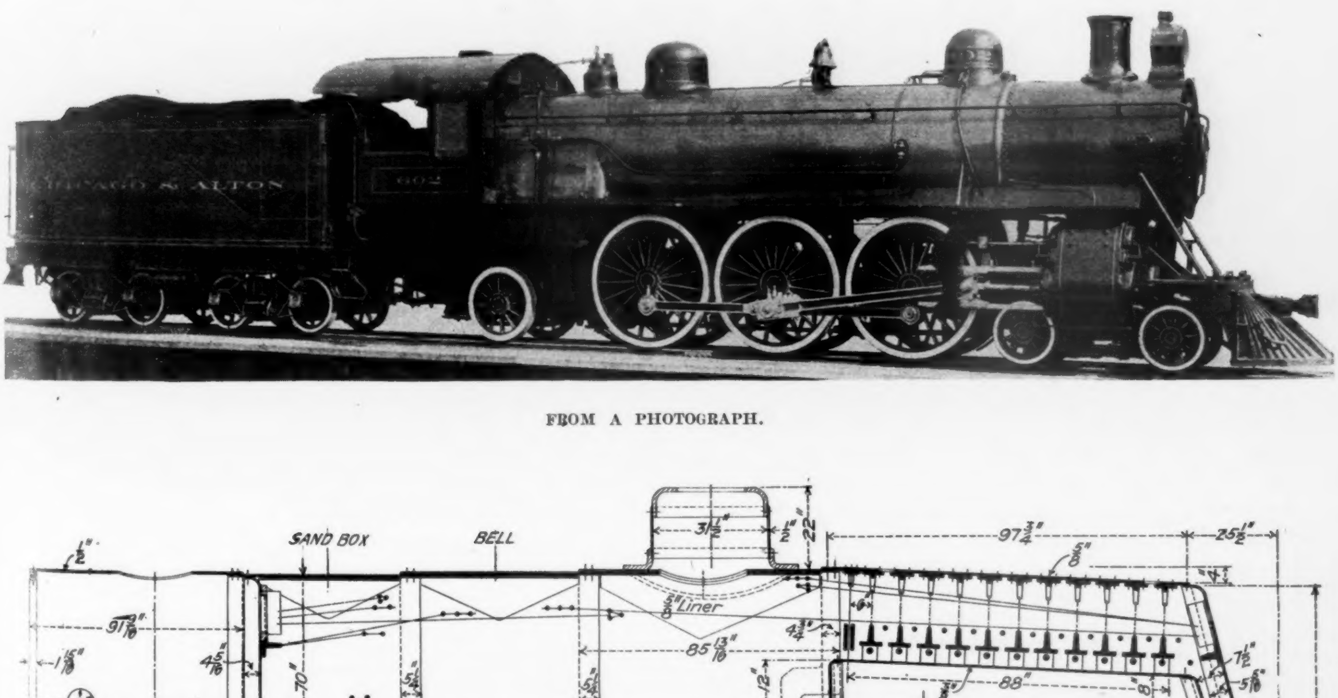
(To be continued.)

A POWERFUL PASSENGER LOCOMOTIVE.

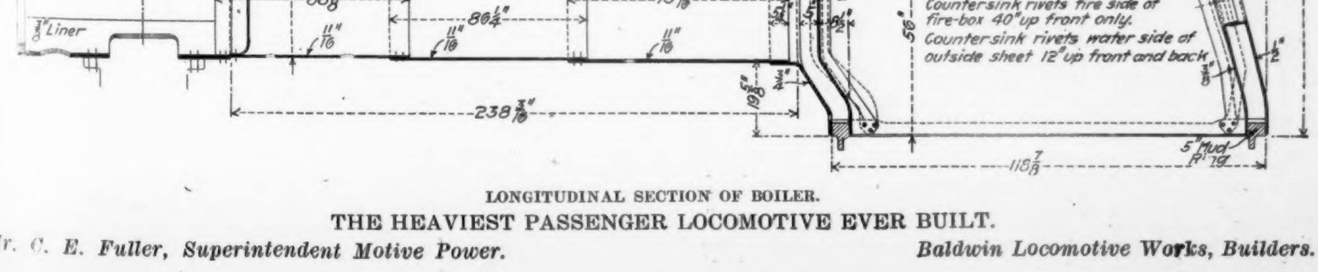
4—6—2 (PACIFIC TYPE.)

CHICAGO & ALTON RAILWAY.

Another record-breaker passenger locomotive has been built for the Chicago & Alton Railway by the Baldwin Locomotive Works. The new one is the heaviest passenger locomotive in the world, and it is specially interesting as a marked example of the present tendency toward a sacrifice of heating surface in order to secure favorable water spaces in the boiler in the hope of avoiding some of the boiler troubles which are becoming more and more serious in connection with the increasing weight of trains. In the March issue of this journal for last year, page 85, were illustrated the very large 4—6—2 type Baldwin locomotives, which were built for the passenger service to the St. Louis World's Fair, and these engines are now followed by a heavier design of the same general arrangement,



FROM A PHOTOGRAPH.

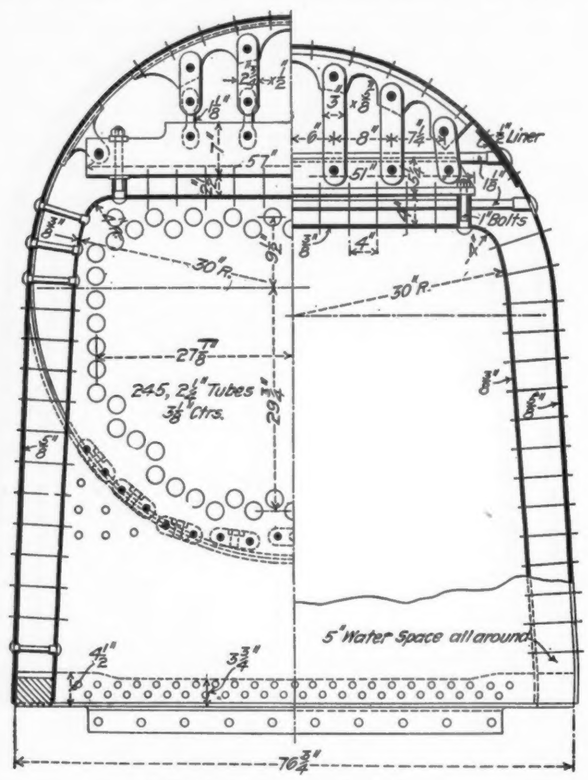


LONGITUDINAL SECTION OF BOILER.

THE HEAVIEST PASSENGER LOCOMOTIVE EVER BUILT.

Mr. C. E. Fuller, Superintendent Motive Power. *Baldwin Locomotive Works, Builders.*

but with quite different boiler conditions. These two designs coming as they do within a year exhibit significant tendencies in boiler proportions which are exceedingly important, and for this reason the leading dimensions are repeated in a table which permits of comparison. Another table shows the ratio of total weight to heating surface of a number of recent large passenger engines. It will be noticed that the new Chicago & Alton engine has 200 lbs. boiler pressure, 245 tubes 2¼ in. in diameter and 20 ft. long, also that the tubes have bridges of ⅞ in. in the tube sheets. Furthermore, the water spaces around the firebox at the mud ring are 5 in. on all sides. These figures indicate the importance which is now given to the matter of circulation space in the boilers, and while the boiler is undoubtedly able to carry 220 lbs., the pressure will



SECTIONS THROUGH FIRE BOX.

not be over 200 lbs., and this should also contribute to long life of the sheets.

When such a radical departure from recent practice is put forth with the approval of the Baldwin Locomotive Works, and the tendency is also apparent in the product of other builders, the facts are worthy of study by all concerned in the American locomotive.

Attention is also directed to the long smoke box and to other features of this design which resemble those of the previous one of this type on this road. Because of the resemblance to the design of last year the general drawings are not reproduced, but special attention is called to the drawings of the boiler.

COMPARISON WITH OTHER LARGE PASSENGER LOCOMOTIVES.

Road.	Engine Number.	Total Weight.	Total Heating Surface.	Total Weight Divided by Heating Surface.
C. & A.	602	221,550	3,053	72.5
C. & A.	601	219,000	4,078	53.7
N. Y. C.	2,794	218,000	3,757	58.2
El Paso & Southwestern	——	209,500	3,818	54.8
Northern Pacific	284	202,000	3,462	58.3
A., T. & S. F.	1,000	190,000	3,738	50.1
C. & O.	147	187,000	3,533	52.9
L. S. & M. S.	650	174,500	3,343	52.2

RATIOS OF CHICAGO & ALTON LOCOMOTIVE.

Heating surface to cylinder volume	= 299.4
Tractive weight to heating surface	= 44.35
Tractive weight to tractive effort	= 5.47
Tractive effort to heating surface	= 8.09
Heating surface to grate area	= 61.55
Heating surface, percentage of tractive effort	= 12.3%
Total weight to heating surface	= 72.5

PASSENGER LOCOMOTIVE, CHICAGO & ALTON RAILWAY.

4—6—0 (PACIFIC) TYPE.

Gauge	4 ft. 8½ ins.
Cylinder	22 x 28 ins.
Valve	Piston
Boiler—Type	Straight
Material	Steel
Diameter	70 ins.
Thickness of sheets	11-16 in.
Working pressure	200 lbs.
Fuel	Soft coal
Staying	Crown bars
Firebox—Material	Steel
Length	108 ins.
Width	66 ins.
Depth	Front, 68 ins.; back, 64 ins.
Thickness of sheets:	Sides, ⅝ in.; back, ⅝ in.; crown, ⅝ in.; tube, ½ in.
Water space	Front, 5 ins.; sides, 5 ins.; back, 5 ins.
Tubes—Material	Iron
Wire gauge	0.125 Mm.
Number	245
Diameter	2¼ ins.
Length	20 ft.
Heating Surface—Firebox	179 sq. ft.
Tubes	2,874 sq. ft.
Total	3,053 sq. ft.
Grate area	49.5 sq. ft.
Driving Wheels—Diameter outside	77 ins.
Diameter of center	70 ins.
Journals	Main, 10 x 12 ins.; others, 9 x 12 ins.
Engine Truck Wheels (Front)—Diameter	33½ ins.
Journals	6 x 10 ins.
Engine Truck Wheels (Back)—Diameter	45 ins.
Journals	8 x 12 ins.
Wheel Base—Driving	13 ft. 4 ins.
Rigid	13 ft. 4 ins.
Total engine	33 ft. 4 ins.
Total engine and tender	62 ft. 8¾ ins.
Weight—On driving wheels	135,110 lbs.
On truck, front	40,500 lbs.
On truck back	45,940 lbs.
Total engine	221,550 lbs.
Total engine and tender (about)	376,000 lbs.
Tank—Capacity	8,400 gals.
Tender—Wheels, number	8
Diameter	36 ins.
Journals	5½ x 10 ins.

COMPARISON WITH PREVIOUS C. & A. LOCOMOTIVE OF SAME TYPE.

Type—Drivers	4-6-2	4-6-2
Type—Name	Pacific	Pacific
Name of railroad	C. & A.	C. & A.
Number of road or class	601	602
Builder	Baldwin	Baldwin
Simple or compound	Simple	Simple
When built	1903	1904
Weight, engine, total, lbs	219,000	221,550
Weight on drivers, lbs	141,700	135 110
Weight on leading truck, lbs	36,300	40,500
Weight on trailing truck, lbs	41,500	45,940
Weight of tender (loaded), lbs	155,000	155,000
Wheel base, driving, ft. and ins	13-9	13-4
Wheel base, total, engine, ft. and ins	32-8	33-4
Wheel base, total, engine and tender, ft. and ins	62-0	62-8¾
Driving wheels, diameter, ins	80	77
Cylinders, diameter, ins	22	22
Cylinders, stroke, ins	28	28
Heating surface, fireoox, sq. ft	202	179
Heating surface, arch tubes, sq. ft	28	....
Heating surface, tubes, sq. ft	3,848.0	2,874
Heating surface, total, sq. ft	4,078.0	3,053
Firebox, length, ins	108	108
Firebox, width, ins	72	66
Grate area, sq. ft	54	49.5
Boiler, smallest diameter of, ins	70	70
Boiler, height of center above rail, ft. and ins	9-5	9-5
Tubes, number, and diameter in ins	328-2¼	245-2¼
Tubes, length, ft. and ins	20-0	20-0
Steam pressure, lbs., per sq. in	220	200
Type of boiler	Straight	Straight
Fuel	Bitum.coal	Bitum. coal
Reference in AMERICAN ENGINEER AND RAILROAD JOURNAL	March, 1903 Page 87	April, 1904

The financial results of the change of motive power of the Manhattan Elevated Railroad of New York City, from steam locomotives to electric traction on the multiple-unit system, has been gratifying and remarkable. The gross earnings during the second quarter of 1903 showed an increase of $414,000 over those of the same quarter of the previous year with steam motive power, while, on the other hand, the expenses in the same time showed a decrease of $99,000; thus the net earnings were increased by $513,000 for that quarter by the change. The electrical equipment was installed with no change in the tracks, rolling stock or character of the traffic, yet the capacity of the system has been greatly increased. The great starting power provided by the multiple-unit system permits six-car trains (all passenger carrying) to be operated with great facility, instead of the five-car trains with steam operation; also the acceleration speed (the determining factor in suburban traffic) has been increased by some 20 or 30 per cent, thus greatly facilitating the quick movement of trains.

A NEW DESIGN OF BACK-GEARED CRANK SHAPER

SPRINGFIELD MACHINE TOOL COMPANY.

The increasing use of high speed tool steels and the heavy duty imposed thereby has made severe demands upon the capacities of machine tools, and is an important factor in influencing new designs of tools. It is of interest to note, however, that the tool builders are keeping pace with the new requirements and are originating new designs of tools to make the extreme heavy cutting duties possible.

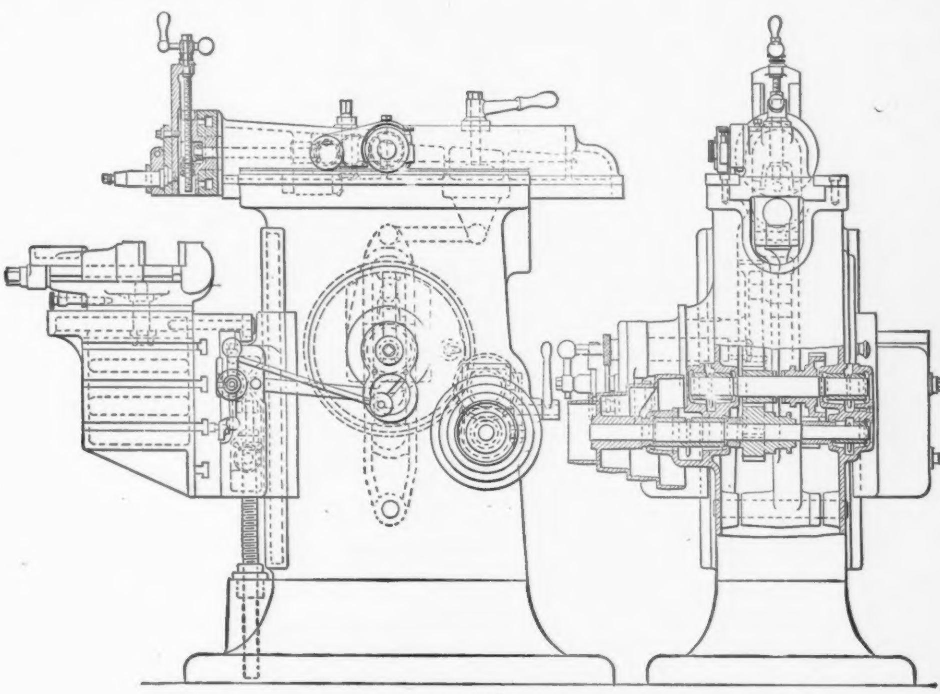
No greater efforts have been made in this line than those of the Springfield Machine Tool Company, Springfield, O., who have recently perfected a new design of 16-in. heavy back-geared shaper. By reason of important changes in this design and improvements to make it adaptable to the heavy work, a description of this tool will be of interest. The general lines of this new tool are shown in the accompanying line engraving. It has a very heavy column or frame, heavily ribbed and of strong design to provide stiffness. The journal boxes of the driving mechanism have bored seats in the column and the flanged sleeve which forms bearing for the crank gear, is fitted into reinforced sections, as shown, to insure steadiness under the heaviest cuts. The top of the column extends beyond the face on each end to provide long bearing surfaces for the ram, and the surface to which the cross rail is clamped is very wide and deep, to give rigid support.

The ram is of semi-circular section and is long, wide and deep. It may be adjusted to suit the work while in motion; the tool head has a graduated swivel adjustable to any angle, and the down feed screw is provided with a micrometer collar.

The cross rail has a long bearing on the column, and is made of extra depth and unusually heavy. It is elevated by means of a screw with ball-bearing thrust. The box table which has a large surface for holding work, is secured to the cross slide by means of two studs and one bolt. The studs are screwed in the box table near its upper surface and pass through the cross slide at points where it is subjected to the pressure of the cut, thus relieving this casting of tension strain. Owing to the extreme depth of cross rail, cross slide and box table, a degree of rigidity is insured which obviates entirely the necessity for an extra support from the shaper base to the box table, therefore, saves the time usually required to adjust this support.

The driving mechanism is arranged for two speeds which, in connection with the wide belt four-step cone gives eight speeds arranged in geometrical progression. The driving shafts are journaled in ring oiling bearings and have large gears with wide faces, which are controlled by a lever at the rear of the column. Provision is made to prevent both sets of gears being engaged at the same time, hence breakage from such causes is avoided.

The stroke of the ram is varied with equal facility, while the machine is in motion or at rest, by means of a heavy wrist block, adjustable in large guides planed into the crank gear. The forward motion imparted to the ram by the driving mechanism is nearly uniform, with a quick return motion. The stroke arm is attached to the ram by means of a connecting rod placed in such a manner that a 2¼-in. shaft may be passed under the ram to allow of key seating.



DETAILS OF THE NEW DESIGN OF 16-INCH BACK GEARED SHAPER.—SPRINGFIELD MACHINE TOOL COMPANY.

The important dimensions of this tool are presented in the following table:

PRINCIPAL DIMENSIONS.

Stroke, maximum	17 ins.
Vertical adjustment of table	15 ins.
Cross motion of table	20 ins.
Tool block feeds (in any direction)	6 ins.
Vise jaws	8 ins. x 11 ins.
Width of front face of column	14½ ins.
Top surface of box table	13 ins. x 11¼ ins.
Depth of cross rail	14½ ins.
Length of bearing in column for ram	26 ins.
Width of ram	8¾ ins.
Size of base	24 ins. x 43 ins.
Floor space required	38 ins. x 80 ins.
Net weight	2,200 lbs.

AMERICAN LOCOMOTIVE COMPANY IN CANADA.

By the purchase of the Locomotive & Machine Company, of Montreal, the American Locomotive Company adds another excellent plant to its equipment. The price paid was $1,500,000, and besides the fine new locomotive plant the property includes a structural steel shop and valuable frontage on the river. The capacity of the locomotive shops is 250 locomotives per year, which may easily be increased to 300.

COKE AS LOCOMOTIVE FUEL.

BOSTON & MAINE RAILROAD.

For a number of years the Boston & Maine has used coke on its locomotives running into Boston and the practice has been described in this journal. Figures from the performance sheets of the last six months of the year 1903 have been received from Mr. Henry Bartlett. These are from passenger service and are not stated in terms of ton miles. They indicate the amount used and the record in train miles for all classes of passenger service.

COKE USED ON LOCOMOTIVES, BOSTON & MAINE RAILROAD.

1903.	*Engine Mileage.	*Tons.	*Engine Miles per Ton.	Passenger Car Miles.	Pounds Used Passenger Service.	Pounds per Passenger Car Mile.
July	391,036	12,192	32.07	602,118	14,155,250	23.51
August	391,288	11,730	33.36	686,636	15,194,180	22.13
September	380,021	11,320	33.57	599,628	13,540,240	22.58
October	382,420	11,871	32.21	559,504	14,406,060	25.75
November	337,606	11,175	30.21	542,526	14,349,940	26.45
December	411,803	14,315	29.37	605,355	16,807,750	27.77

*All classes of service.

PROPOSED STANDARD SPECIFICATIONS FOR LOCOMOTIVE CYLINDERS.

Committee B, of the American Society for Testing Materials, proposes the following specifications for locomotive cylinders:

Process of Manufacture.—Locomotive cylinders shall be made from good quality of close grained gray iron cast in a dry sand mold.

Chemical Properties.—Drillings taken from test pieces cast as hereafter mentioned shall conform to the following limits in chemical composition:

	Per cent.
Silicon	From 1.25 to 1.75
Phosphorus	Not over 0.9
Sulphur	Not over 0.10

Physical Properties.—The minimum physical qualities for cylinder iron shall be as follows: The Arbitration Test Bar, 1¼ inches in diameter, with supports 12 inches apart, shall have a transverse strength not less than 2,700 pounds, centrally applied, and a deflection not less than 0.08 inch.

Test Pieces and Method of Testing.—The standard test shall be 1¼ inches in diameter, about 14 inches long, cast on end in dry sand. The drillings for analysis shall be taken from this test piece, but in case of rejection the manufacturer shall have option of analyzing drillings from the bore of the cylinder, upon which analysis the acceptance or rejection of the cylinder shall be based. One test piece for each cylinder shall be required.

Character of Castings.—Castings shall be smooth, well cleaned, free from blow holes, shrinkage cracks or other defects, and must finish to blue print size. Each cylinder shall have cast on each side of saddle manufacturer's mark, serial number, date made and mark showing order number.

Inspector.—The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy himself that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of the manufacturer.

The following is schedule of fast run made by a Chicago & Alton Railway special train carrying Mr. Pabst, the prominent brewer, and his party, Chicago to St. Louis, February 13, 1904:

Left Chicago	2.43 P. M.
Arrived Joliet	3.35 P. M.
Arrived Bloomington	5.24 P. M.
Arrived Springfield	6.38 P. M.
Arrived St. Louis	8.55 P. M.

Elapsed time six hours and twelve minutes, which included stops of seven minutes for train orders, six minutes in changing engines, eight minutes for obtaining water and one minute on account of being held by adverse signals. Total time lost by necessary stops, twenty-two minutes, which, substracted from elapsed time, gives a net running time of five hours and fifty minutes for the 283 miles.

PROPOSED STANDARD SPECIFICATIONS FOR MALLEABLE CASTINGS.

Committee B, of the American Society for Testing Materials, proposes the following specifications for malleable iron castings:

Process of Manufacture.—Malleable iron castings may be made by the open hearth, air furnace or cupola process. Cupola iron, however, is not recommended for heavy nor for important castings.

Chemical Properties.—Castings for which physical requirements are specified shall not contain over 0.06 sulphur nor over 0.225 phosphorus.

Physical Properties.—1. *Standard Test Bar.*—This bar shall be 1 inch square and 14 inches long, without chills and with ends left perfectly free in the mold. Three shall be cast in one mold, heavy risers insuring sound bars. Where the full heat goes into castings which are subject to specification, one mold shall be poured two minutes after tapping into the first ladle, and another mold from the last iron of the heat. Molds shall be suitably stamped to insure identification of the bars, the bars being annealed with the castings. Where only a partial heat is required for the work in hand, one mold should be cast from the first ladle used and another after the required iron has been tapped. 2. Of the three test bars from the two molds required for each heat, one shall be tested for tensile strength and elongation, the other for transverse strength and deflection. The other remaining bar is reserved for either the transverse or tensile test, in case of the failure of the two other bars to come up to requirements. The halves of the bars broken transversely may also be used for tensile strength. 3. Failure to reach the required limit for the tensile strength with elongation, as also the transverse strength with deflection, on the part of at least one test rejects the castings from that heat.

4. *Tensile Test.*—The tensile strength of a standard test bar for casting under specification shall not be less than 42,000 pounds per square inch. The elongation measured in 2 inches shall not be less than 2½ per cent.

5. *Transverse Test.*—The transverse strength of a standard test bar, on supports 12 inches apart, pressure being applied at centre, shall not be less than 3,000 pounds, deflection being at least ½ inch.

Test Lugs.—Castings of special design or of special importance may be provided with suitable test lugs at the option of the inspector. At least one of these lugs shall be left on the casting for his inspection upon his request therefor.

Annealing.—Malleable castings shall neither be over nor under annealed. They must have received their full heat in the oven at least 60 hours after reaching that temperature.

Finish.—Castings shall be true to pattern, free from blemishes, scale or shrinkage cracks. A variation of 1-16 inch per foot shall be permissible. Founders shall not be held responsible for defects due to irregular cross sections and unevenly distributed metal.

Inspection.—The inspector representing the purchaser shall have all reasonable facilities given him by the founder to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made prior to shipment.

THE TECHNOLEXICON.

A brief statement has been received from the secretary of the Society of German Engineers indicating the work done in connection with this universal dictionary of technical terms up to February, 1904.

The universal technical dictionary for translation purposes, in English, German and French, the compilation of which was begun in 1901 under the auspices of the Society of German Engineers, has received help up to the present time from 363 technical societies at home and abroad: 51 of these are English, American, South African, etc., 274 German, Austrian and German-Swiss and 38 French, Belgian and French-Swiss societies. Of firms and individual collaborators 2,573 have promised contributions. The excerption of texts in one, two or three languages (handbooks, pamphlets, business letters, catalogues, price lists, etc.) and of the existing dictionaries has yielded 1,920,000 word cards so far. To these will be added within the next two years (by the middle of 1906) the hundred thousands of word cards that will form the result of the original contributions.

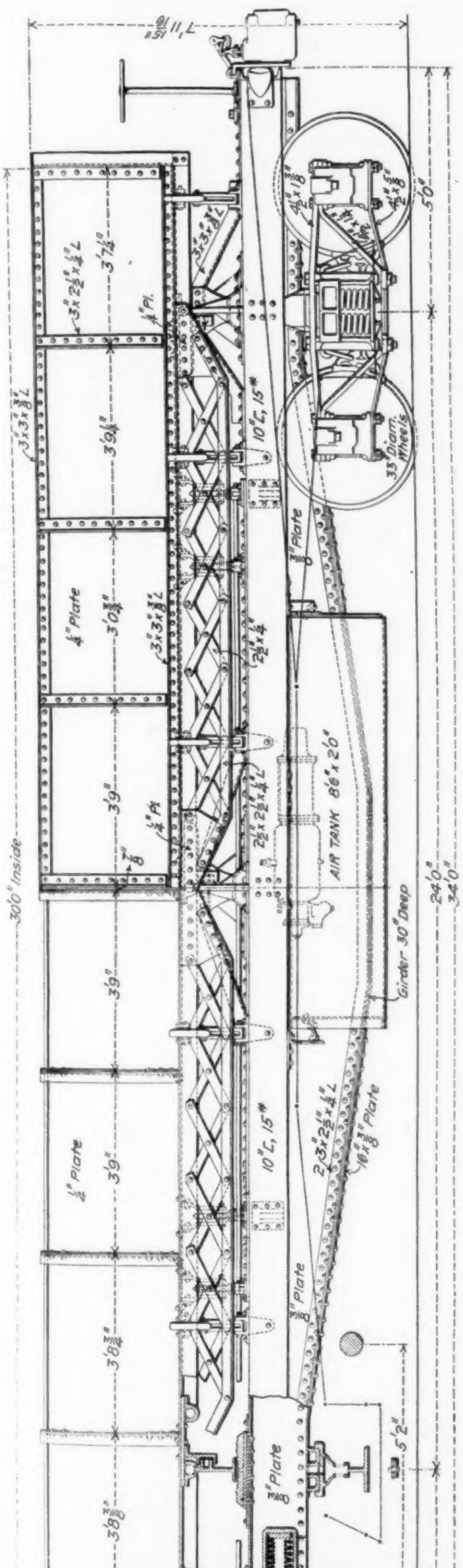
All the outstanding contributions will be called in *by Easter of this year*, 1904. The collaborators are therefore requested to close their note-books or other contributions—unless a later term has been especially arranged with the editor-in-chief—by the end of March and to forward them to the address given below. As the printing of the Technolexicon is to begin in the middle of 1906, delayed contributions can be made use of in exceptional cases only up to that time.

The editor-in-chief will be pleased to give any further information wanted. Address Technolexicon, Dr. Hubert Jansen, Berlin (N. W. 7), Dorotheenstrasse 49.

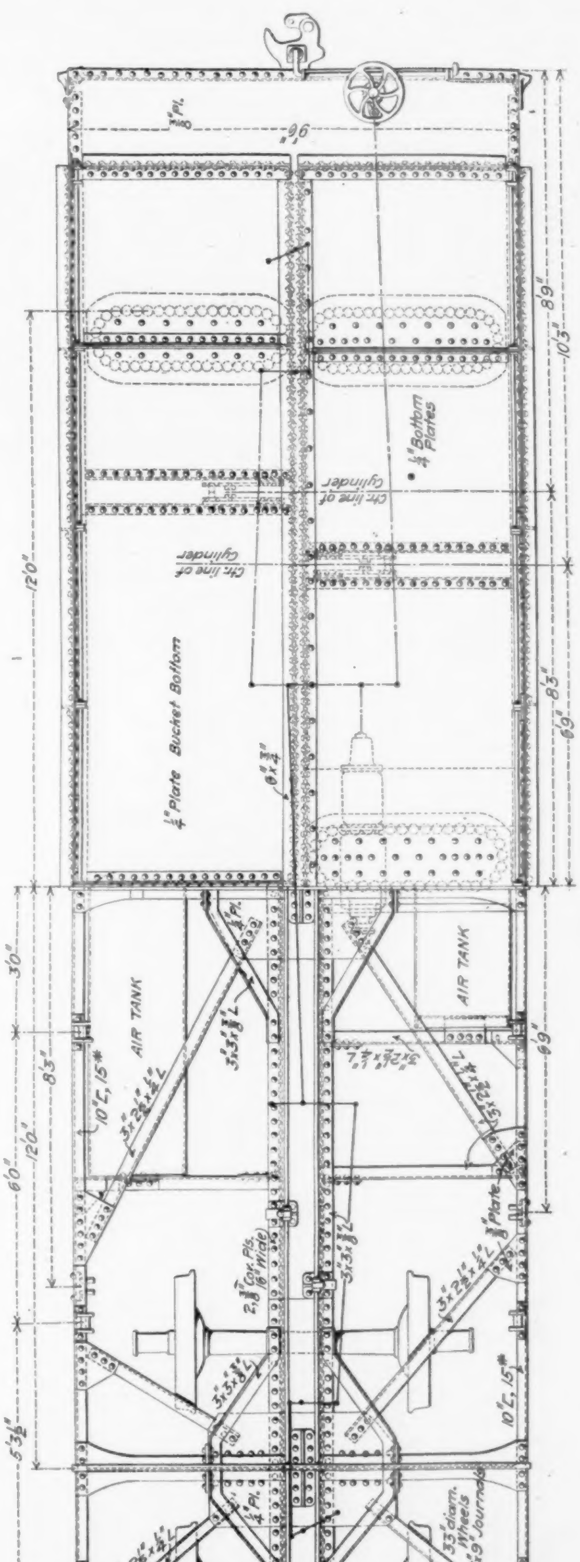
THE LAWSON IMPROVED DUMPING CAR.

This car has passed out of the experimental stage and is ready for service in the exacting work to which equipment of this kind is subjected in handling ballast, ore and other material which must be loaded conveniently and unloaded quickly. Severe service tests have demonstrated its satisfactory operation and orders have been placed for a number of cars to be built by the Middletown Car Works.

The Lawson car carries its load in two long, plate steel boxes, each having a cubical capacity of about 415 cu. ft. When these are in the loading position they rest upon three cast steel transverse supports which are provided with ball races. In dumping, compressed air is admitted to oscillating cylinders, two for each box, which first slide the box toward the side of the car and then tilt it to dump out the load through the side doors, which are automatically unlocked by devices which in operating, pass out of the way of the load



SIDE ELEVATION AND PARTIAL LONGITUDINAL SECTION.

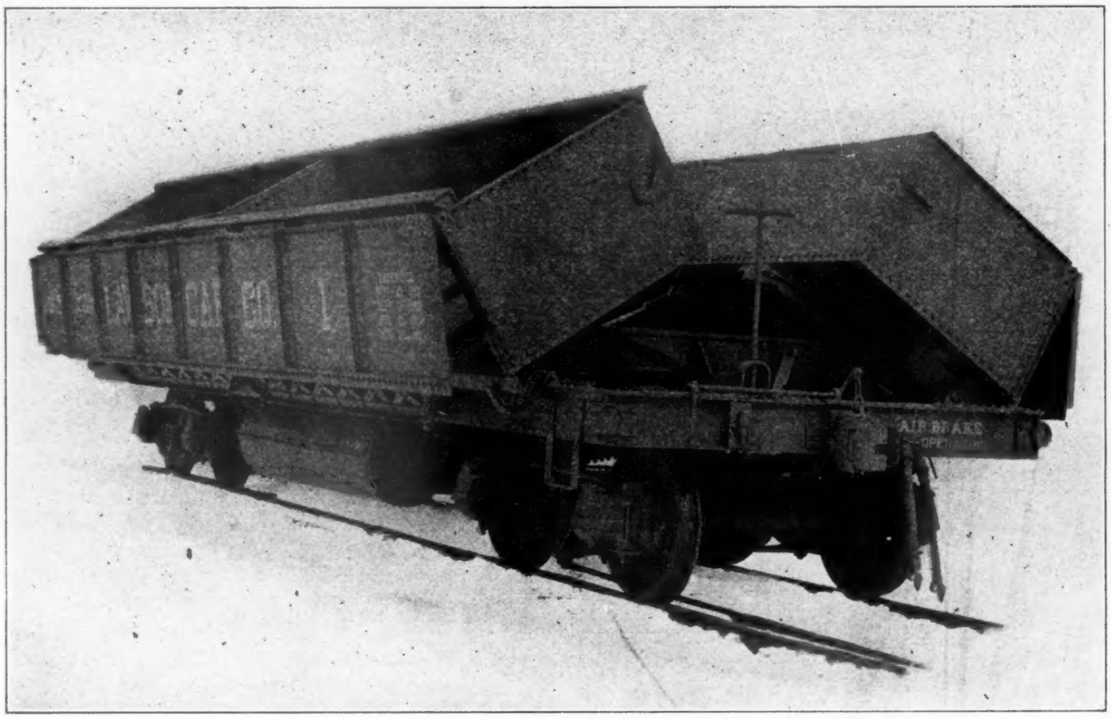


HALF PLAN OF CAR AND UNDERFRAMING.

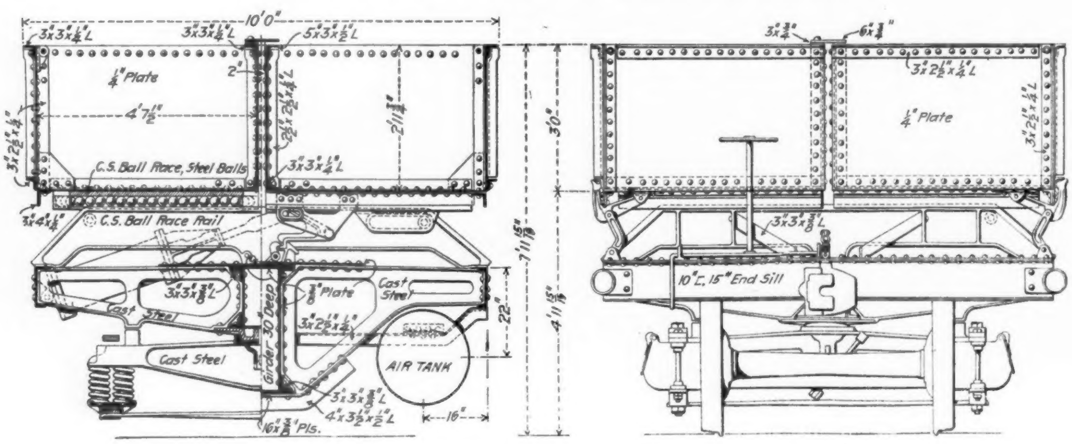
THE LAWSON IMPROVED DUMPING CAR.

and are protected by the floor of the box. After dumping, the cylinders restore the box to its normal position and the door locks return automatically into position to close the doors tightly and the car is again ready for loading. To accomplish this, a surprisingly small number of parts are required. In fact, it appears to be the simplest mechanism possible to use for such work.

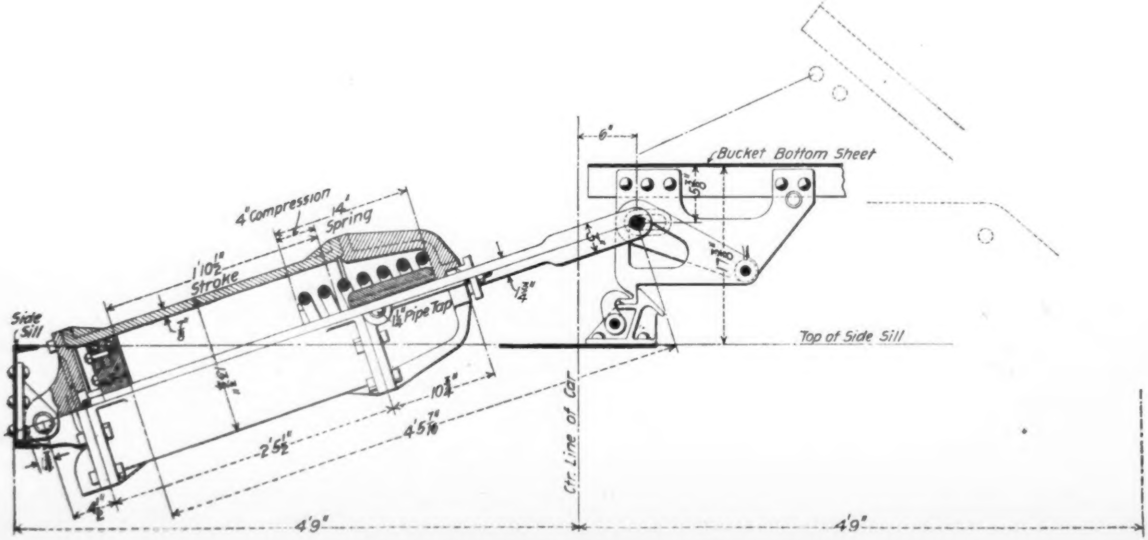
The under frame has a back bone of box girder construction which is 30 ins. deep at the center of the car and tapers toward the body bolsters. The side sills are 10-in. channels and the center and side sills are strongly connected and braced by angles and large gusset plates, as indicated in the plan view. The body and also the truck bolsters are of cast steel, their form being clearly shown in the engravings. In the sectional



LAWSON DUMP CAR WITH BOTH BOXES IN DUMPED POSITION.



END ELEVATION AND CROSS-SECTION, SHOWING BOLSTERS.



DETAIL OF OPERATING CYLINDER AND LATCH.

THE LAWSON IMPROVED DUMPING CAR.

end view of the car the arrangement of the air cylinders and their slotted attachments, also the slotted hinge connections to the boxes are shown.

In order to provide sufficient power for dumping the load with low pressures of air the cylinders are 12 ins. in diameter, which insures sufficient power with air pressure as low as 40 lbs. per sq. in. An air reservoir 24 ins. in diameter by 8 ft. long, gives sufficient supply for four complete operations, even if the hose is uncoupled from the engine. This cylinder connects with the air brake train pipe, and a check valve prevents the reservoir air from passing back into the train pipe. The leading dimensions of the car are given in the accompanying table.

LAWSON DUMPING CAR.

Length over end sills	34 ft.
Length inside of boxes	30 ft.
Height, rail to top of boxes	3 ft.
Height to floor of boxes	5 ft.
Width over side sills	9 ft. 6 ins.
Width of boxes, inside	4 ft. 7½ ins.
Depth of each box	2 ft. 11¾ ins.
Weight of car	50,000 lbs.
Capacity	830 cu. ft., 40 tons

In the photographic side view lattice girders are seen, under the sides of the boxes. These are used to stiffen the floors of the boxes. The construction throughout is very strong, which was done to provide for stresses due to possible rough handling in shaking out a frozen load. To operate the air conveniently the controlling valves are placed upon the platforms at the end of the car. Records of tests are at hand showing that loads of ordinary material have been dumped and the car put into position for loading in 50 seconds. This car, which was recently tested on the Central Railroad of New Jersey, has a capacity of 40 tons. It has been tested with 95,000 lbs. of frozen ore with entirely satisfactory results. Very ingenious locking devices are provided. They lock and hold the sides firmly in place and release automatically when the boxes are raised for dumping. Being operated by linkages, the locks draw away from the door and pass under the floor where they are out of the way of the load. Six of these locks are provided on each side of the car. Additional locks are applied to the air cylinder piston rods to prevent the cylinders from accidental operation. In dumping a load the pistons of the air cylinders are brought up against heavy spiral springs which surround the piston rods and provide a resistance capacity of about 8,000 lbs. in closing 4 ins. This makes it possible to shake out a refractory load and insures clearing all the load.

The writer raised the question of the stability of this car in dumping one side when the other side is empty and was informed that frozen ore has been shaken out of one side under these conditions without raising the wheels on the empty side or otherwise indicating any lack of stability. The details of this design were worked up by the Commonwealth Steel Company and the cars are being built by the Middletown Car Works, Middletown, Pa.

This type of dumping car seems to be the best which has thus far been developed for such work as trestle filling, ballast handling and general construction work. It is highly spoken of by railroad officials who have tested it. Further information may be obtained from the Lawson Improved Dumping Boat & Car Company, 260 West Broadway, New York City.

SOMETHING EVERY RAILROAD SHOULD PROVIDE.

At the Point St. Charles shops of the Grand Trunk Railway at Montreal, Mr. William McWood, superintendent of the car department showed a representative of this journal a reading room and mess room which have been maintained at that point for 46 years. The library receives regularly 93 periodicals and has nearly 11,000 books. The attendance in the reading room last year was 40,500. The Grand Trunk Railway Literary and Scientific Institute is the name of this institution, which is encouraged by the company and assisted by the local officials. Members pay ten cents per month or $1.00 per year for the use of the reading room, astronomical telescope, maps, globes, air brake apparatus sectioned, link and valve motion models, reference library and admission to lectures and classes. Mechanical drawing classes meet twice a week and other classes study the air brake, valve motion, etc. Prizes to the value of $15.00 are given annually to the mechanical drawing class.

The messroom adjoins the library in a building opening into the shop grounds on one side, and near the entrance gate. At one end of the room is a stage for theatrical performances and the room is supplied with long tables and benches. On each side of the room is a large steam oven. Shop men who live at a distance from the works bring their lunches and leave their "dinner pails" at the messroom in the morning. These are placed in the ovens before the noon hour by a regular attendant who keeps the room in order. At noon the men find their lunches hot and ready for them. They enjoy them together at the tables and after 12.30 smoking is allowed. Out of a total of about 2,500 men at these shops an average number of about 500 make daily use of this room, and it is not necessary to dwell upon the advantages to the company derived from this provision of a pleasant, warm and very comfortable room in which to spend an enjoyable hour by those who otherwise would gather in knots of four or five roosting in sundry uncomfortable and not too attractive corners of the shops where the working hours are spent.

The writer was greatly impressed with this simple inexpensive and eminently sensible contribution on the part of the company to the comfort of the men. It is handled in exactly the right way and has been through the test of 46 years. Why does not every railroad do likewise?

PROTECTING COATING FOR AIR BRAKE HOSE.

Deterioration of rubber when exposed to the atmosphere has led to many attempts to secure a satisfactory protection which will keep the air from the rubber and prolong its life by preventing the formation of weather cracks.

The editor of this journal has had his attention drawn to a very promising experiment with a material prepared for this purpose by two gentlemen who have had wide experience in the use of air hose on cars. They applied the material which they made to half the length of a piece of hose and left the other half in its original condition. After exposure to the atmosphere where it was in all kinds of weather for thirty months, the half which was covered with this interesting material was in perfect condition, while the unprotected portion had weather cracks clear through the rubber. The gentlemen referred to state that the cost of this material is low and that they are sure it will absolutely prevent weather cracks in the outside cover of the hose. It will soon be placed on the market, and our readers will be informed of the fact, as this appears to be a very promising development in the protection of air hose.

REDUCED CLEARANCE ON A LOCOMOTIVE.

In connection with the general subject of reducing clearance in locomotive cylinders a circumstance which occurred on a Southern road has been brought to our attention. Some new locomotives were found to be wasteful of fuel and also "logy" and "lame." Indicator cards were taken, and by setting the valves with greatly increased lead the cards were improved. It was found necessary to give ¼-inch lead in full gear to accomplish it, and the engines were not improved as to starting or as to fuel consumption. It was then discovered that the clearance was too great and that a mistake had been made by the builders, in the thickness of the pistons. By increasing the thickness 1 inch and reducing the clearance to about 8 per cent. the trouble was remedied and a material saving in fuel resulted. These engines were burning wood, and the saving amounted to from four to five cords of wood per round trip, where the wood cost $5 per cord.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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A CRITICAL STUDY OF ROUNDHOUSES.

The subject treated by Mr. R. H. Soule in this issue is of transcendent importance. Because of its influence upon efficient locomotive operation the roundhouse now receives a large amount of attention and the necessity for liberal construction appropriations is becoming appreciated. In his railroad experience Mr. Soule was a leader in roundhouse improvement and he consistently advocates increased head room, large spans of roof, absence of intermediate roof supports, good drop pits, ample natural lighting and adequate shop facilities and tool equipments. In this article will be found a table of dimensions for roundhouses which presents information which locomotive men and civil engineers will both find to be helpful in laying out new roundhouses, and taken as a whole it is believed that no safer guide to practice is available than the discussion contained in this article.

LOCOMOTIVE REPAIR RECORDS.

A Rational System.

In order to operate the mechanical department of a large road in accordance with business principles, it is necessary to know the cost of locomotive repairs at each shop, and to have an intelligent basis for comparing one shop with another. The comparison of the records of one road with another are not now under consideration.

Repair records expressed in cost per mile are almost valueless, because they contain no information as to the amount of work done and they consider heavy and light locomotives on the same basis. No one would for a moment consider paying money out of his own pocket for repairs to a miscellaneous lot of locomotives, doing a variable quantity of work on such an indefinite and obscure basis as the miles made in service. It is too indefinite. Motive power officers must find a better method of expressing their shop performances if they are to meet the need of the times for commercial management of their department.

In this issue is printed a description of a plan for classifying locomotive repairs which is to go into effect on one of the large railroad systems and it is presented in this journal with the conviction that it is one of the most important articles contained in these pages for years. This plan is a step in the direction of commercializing railroad motive power matters, which should be carefully studied and put into effect generally, because it permits of comparing the work of various shops and bringing all up to the standard of the best.

This system is based upon the assumption that the cost of repairs is roughly proportional to the weight of the locomotive and the mileage it makes. The output of a shop is better stated in terms of weight than in number of locomotives of varying weight. The cost is also proportional to the work done by the engines.

Unless the roundhouse or running repairs are also kept on the ton mile basis there is no way of knowing absolutely the proportion of running and shop repairs, but the running repairs may be kept on the ton mile basis also.

INFORMATION.

Two kinds of information are necessary for the successful conduct of any enterprise requiring the concerted efforts of a large organization. Before the plan of operation can be formed information must be had upon which to build the plan and arrange the campaign. This fact is very generally understood and many men know how to begin the management of an enterprise and many who are called to undertake the management of difficult work begin promisingly but fail because they do not appreciate the necessity for another kind of information which is quite as important and quite as necessary as that which forms the basis of the plan. In a large organization the chief officer must necessarily issue instructions. This also is easy, but it is not easy to know positively that the instructions are understood by the subordinates and that they are being carried out. This is the information, the lack or the possession of which determines success or failure of those who manage men.

A military officer who issues the right instructions to his subordinates and then makes sure, through his aids, that they are carried out, is a "genius." He would not be one if he issued the best possible instructions and yet failed to inform himself upon every movement of his forces in order to know how his instructions were being carried out.

The writer recently had an opportunity to watch a very successful railroad officer in the handling of a rather difficult labor question. Every step was based upon information concerning a rapidly changing situation and the affair was concluded with everybody happy. The work was all done by subordinates who acted under his directions, each one carrying out his instructions and reporting the result. This reporting was as vital a factor as the instructions.

In the management of a department of a railroad it is often quite difficult to know whether circulars of instructions are understood and obeyed. It becomes necessary to occasionally revise and change such instructions, and the department chiefs who succeed are those who know either by personal observation, or by some other means, whether the subordinates are doing what is expected of them. On a large road it is impossible for him to know by observation, and it becomes necessary to establish a plan which will take its place. This matter has been referred to before in these columns, but it is sufficiently important to justify repetition.

A superintendent of motive power, who is well known as a successful man, requires his chief clerk to send out, at intervals of three months, a blank form to all the master mechanics and others who have occasion to work under general circulars of instructions. The circulars are numbered as issued, and on these forms each subordinate is required to report the number of the circulars under which he is working and to state that he has just read the instructions and fully understands them. A man making such a report either has just read the circulars and understands them or he prevaricates, for an answer is required from all. This enables the chief to keep a check upon the instructions, it aids him in keeping them up to date and gives him a valuable check upon the part of his work which is controlled and directed in this way. This is a commendable plan, and one which is worthy of wide acceptation and adoption.

These remarks suggest another upon the value of statistics as a help in the administration of a department. There is probably no lack of statistics on any well-managed railroad. It is one thing to secure working statistics and quite another thing to use them. There are various kinds of statistics. Many figures are collected and reported upon blanks, only to be deposited in an imposing array of files, to become dusty additions to dusty collections of preceding files. Others are vital working tools for immediate use and for comparison with other statistics showing whether the curve of efficiency is rising or falling. These are the living figures which indicate how well the instructions are framed for the subordinates and how effectively they are carried out.

Upon the instructions, the knowledge that they are being carried out and their effectiveness when carried out, much of the success of the administration of the department depends.

Specialists who through careful study and experience in management of industrial enterprises are able to modernize the management of manufacturing plants are much in demand today, simply because they understand and are able to put into effect the principles under discussion in these paragraphs.

No branch of mechanical management offers a more favorable field for such effort as the motive power departments of railroads and that officers of these departments are seriously studying these principles is a conspicuous "sign of the times."

An important and significant appointment of a consulting mechanical engineer for the Southern Railway and its allied lines is announced on another page of this issue. In the movement of the past few years toward the concentration of ownership and operation of railroads into large systems there lies an opportunity for great improvements leading to substantial economies through the application of the principles which have contributed in a large way to the financial successes of other industrial combinations. This appointment renders it possible to apply standardizing methods to a large mileage with no harmful possibilities and with promise of large savings which may be secured by using uniform construction for equipment. The owners of large properties are beginning to appreciate the advantages of this policy and a new era is opening in which things relatively small in themselves are becoming large by aggregation and they must be handled in a broad and liberal way. Those who hold the responsibilities for the design of railroad equipment and shops have new problems before them and their work is continually increasing in importance. The care of design and construction of the mechanical equipment of 12,000 miles of railroad is a charge worthy of the best talent, and outside of the management of the operation of the lines and the administration of labor there is scarcely a more important trust than this. It necessarily involves knowledge, experience and business ability which the owners of railroad systems will do well to recognize and encourage.

Mr. W. E. Chester has been appointed general master mechanic of the Central Railroad of Georgia with headquarters at Savannah, Ga. Mr. W H. Fetner has been appointed to succeed Mr. Chester as master mechanic at Macon, Ga.

LOCOMOTIVE REPAIR RECORDS.

ENGINE TON MILES AS A MEASURE OF WORK DONE.

A RATIONAL SYSTEM.

This article describes a new system which is about to be tried on one of the large railroads. It is considered one of the most important articles appearing in these pages in a long time.—EDITOR.

UNIFORM SYSTEM OF CLASSIFYING REPAIRS TO LOCOMOTIVES.

The reasons for which a classification was required may be expressed as follows:

First, to ascertain mileage or duration of service to be expected, before requiring further repairs, from engines turned out each month from the various shops, in order to determine the average condition of power and whether same is improving or deteriorating;

Second, to enable a rough comparison to be made of the output of any shop as compared with other shops or with its previous record;

Third, to advise mechanical officers not concerned with the shops of the general condition of the engines when turned out.

In order to intelligently discuss the classification necessary to furnish information to satisfy item 1, it is necessary to explain the system adopted on the various roads for keeping account of the condition of power. On this road this consists of a statement of the general condition of the engines as determined principally by tire wear and the number of month's service which may be expected from them, whereas on the other roads concerned a record is kept of the mileage made by each engine since it last underwent general repairs, or in the case of flues, since flues were last renewed. Knowing the average mileage which may be expected from one general repair to another for machinery and the mileage which is obtained from one renewal of flues to another, the average condition of the power is obtained, by determining the average mileage for all engines or for each class of engines made since last general repair or since last renewal of flues. If this average is above half the mileage which may be expected between general repairs or flue renewals it shows that the condition of power is below normal; if it is below the condition of power it is above normal. At the same time by obtaining the mileage to be expected from engines turned out of shop each month that have had machinery and flue repairs it is possible to ascertain whether the condition of power has been improved or not during that month. Both of these classifications require information in common, therefore, first as to whether an engine turned out of the shop has undergone general repairs or not; secondly, as to whether or not the flues have been renewed.

Previous classifications have depended largely upon two distinctions; first, on whether the engines repaired had light or general repairs to their machinery; secondly, on the amount of boiler work done, whether flues were replaced, new firebox or new boiler applied. So far as the last two items are concerned, they may be ignored by the classification so far as condition of power is concerned. If an engine is turned out of a shop it is presumed that the firebox will be put in sufficiently good condition to continue in service until next shopping. The same remarks apply to the boiler, and if the application of a new boiler alters the design sufficiently to change the class of the engine, all concerned are thus notified.

The above remarks do not apply to any consideration of shop output, but simply to items 1 and 3, and for this purpose the following classification of repairs is proposed:

Class 1 General repairs to machinery.
Class 2 Light repairs to machinery.
Class EH Engine house repairs.
Class A Accident repairs.
Class W Wreck repairs.

And that letter "F" be suffixed to any of the above classes to indicate flues renewed.

The difference between Class 1 and Class 2, repairs can be determined by the superintendent or general foreman at the shop; in general it is intended that if engines are taken in for flues or tire turning, after making 40,000 to 60,000 miles or so, and are given light machinery repairs and not thoroughly overhauled, they are classified as Class 2. Engines shopped after 70,000 or 80,000 miles and receiving a general overhauling are classified as Class 1, indicating that they are put into condition to make fresh mileage on that date, or that they are turned out of the shop in first-class condition. So far as machinery, firebox and boiler work are concerned if an engine has received Class 2F repairs it indicates that it has received light repairs to machinery and that flues have been renewed so that they are ready to run their expected time or for their expected mileage.

Engine house repairs are incidental repairs made in the main shops for the sake of convenience or economy, but which may properly be considered as roundhouse work; as will be seen later, the distinction between these repairs and Class 2 can be left to the decision of the shop or division force on the system proposed without affecting the output of the shop.

Accident repairs are those due to breakage of machinery or other occurrences for which the mechanical department is responsible.

Wreck repairs are those due to collision or derailments, etc., for which the operating department is properly responsible.

Class A and W repairs may of course be combined with Class 1 or 2 and F repairs, if condition of engine justifies it. Thus an engine may receive Class A-1-F repairs, indicating that it was shopped on account of accident, but that condition of engine at that time warranted its undergoing a general overhauling with renewal of flues. The question of the number of flues to be renewed to justify repairs being classified as F should be left to the division force subject to other instructions, but if an engine is reported as F repairs, even if all flues are not replaced, it must be understood that all flues not taken out are in sufficiently good condition to make mileage equal to the new flues which are put in so that flue mileage can be properly started at that shopping.

This classification satisfies the requirements of items 1 and 3, but to afford information as to whether condition of power is improving or not it would be necessary for shops to report mileage made by engines having Class 1 and F repairs turned out each month and on the assumption that these engines will make as good mileage in the future as they have in the past, this figure for each class of engines would determine whether the condition of that class had been improved or not. The mileage reported would of course be the mileage since the previous Class 1 or F repairs.

To satisfy item 2 in which the engines undergoing a certain class of repairs are used as a criterion of shop output a different system must be employed.

Classes EH, A and W repairs are exceedingly variable. The shops are not in control of their expenditures on them and they should be eliminated entirely from any consideration of shop output and be considered separately. This can be done by separating both the output of this class of repairs and its cost each month together with its proper proportion of expense from the remaining output and expenditure at the shop, leaving the balance of cost which may be considered as the equivalent of the output of regular repair work.

Expense for manufacturing work and work done for roundhouses should be separated in the same way from the regular repair work at each shop in considering its output.

Inasmuch as boiler work and machinery repairs are made in different departments these could be subdivided so that a shop would be considered as turning out a certain amount of machinery repairs, renewing a certain number of flues, and applying a certain number of new fireboxes and new boilers each month or period. If preferred flues could be considered as being in sets, but we believe that the better plan would be simply to state that a certain number of flues were renewed. For firebox work the total number of firebox sheets applied in any month should be divided by four to obtain the output of new fireboxes. It is certain that in the case of a shop applying a number of side sheets, or repairing several engines each requiring three or four firebox sheets, that the cost will be considerably higher than if the same number of sheets were applied in completed boxes.

It is difficult to say just how many sheets would on the average represent the cost of a completed firebox were they put in separately, but for the present four sheets may be considered equivalent to one firebox. This arrangement would overcome to a large extent the present discrepancy in the cost of repairs of the same class on the road occasioned by the distinction between an engine having general machinery repairs without firebox work and one having same machinery repairs, but receiving two or three new sheets in the firebox. Even in the classification in which a class of repairs is assigned to, engines having general machinery repairs and one or more firebox sheets, but not a complete firebox, there is a large discrepancy between the costs on account of the variation in the amount of firebox work. The number of new boilers applied can of course be readily arrived at and there does not seem to be any possible way of taking of miscellaneous boiler repairs other than flues or firebox without being too complicated.

This leaves the output of machinery repairs to be considered and in this connection two points of difficulty arise; the first is that for repairs of the same class the cost varies widely dependent on the size of the engine; the second is that repairs of the same class on engines of equal size will represent a large difference in the amount of work to be done. There appear to be two widely different practices in vogue; in the first an engine is brought in after 50,000 to 80,000 miles and undergoes a general overhauling, the work done in the meantime being properly classified as engine house; in the second an engine obtains light repairs after 40,000 to 60,000 miles service and general repairs at 90,000 to 120,000 miles. Without determining as to which of these should be considered the best method it is evident that on an engine obtaining three general repairs in 300,000 miles' service or possibly two in 240,000 miles such a general overhauling will be more expensive than on the engine which obtains four general repairs in 300,000 or three in 240,000 miles service.

In regard to the first question, namely, the variation in cost of a given class of repairs on account of the size of the engine there is but little question that the cost is roughly proportional to the weight of the engine. The cost of material certainly varies almost directly in this proportion and figures which have been investigated indicate that the total cost is, if anything, fully proportional to the weight. The question is really one of whether the number of engines or whether the weight of engines is most nearly proportional to the work done, and as a matter of fact if the cost of repairing a 100-ton engine is more than 140 per cent. of the cost of repairing a 50-ton engine, then the tonnage basis is more accurate than the engine basis; if less of course the engine basis would be more accurate. This practically proves from costs we have obtained that the tonnage basis is the more accurate and should be adopted; in other words that the output of a shop should be measured by the tons of engines turned out rather than by the number. The cost of overhauling engines is certainly also affected by the mileage. It may not be directly so. Thus an engine that has run 70,000 miles may have so much work done on it that it costs as much to repair, as an engine that has run 100,000 miles, but taking this question broadly, the shops are keeping engines in repair year after year and the shop that adopts the best system for taking them in and over a life of 300,000 or 400,000 miles repairs these engines for the minimum cost per mile, is presumably doing the best work. It may be objected that the cost per mile is largely dependent upon the manner in which the engine has been maintained while in service. This is certainly true, but at the same time the work to be done under any classification of repairs is dependent on the same factor. No classification can allow for an engine coming in in good or poor condition on account of its maintenance at the roundhouses and it would appear that the fairest way to measure the output would be by the mileage made by engines repaired. If this is granted, namely

that the output should vary as the mileage made by engines repaired and as their weight then a very simple method of comparison can be employed for machinery repairs. A 100-ton engine that has made 100,000 miles, or multiplying these two amounts together 10,000,000 ton miles of engine repairs may be taken as a unit; and a shop can then be credited as turning out each month a certain number of units of machinery repairs dependent on the number of units that the total sum of the mileage for each engine turned out since last 1 or 2 repairs multiplied by its weight is equivalent to. One of the advantages of this system is that it eliminates all discussion so far as output is concerned as to whether an engine has a Class 2 or Class EH repairs. If a shop chooses to consider an engine that has made 30,000 miles as a Class 2 repairs, it simply loses that amount of credit the next time the engine is shopped; if it calls such a repair Class EH the next time the engine is shopped the output obtains credit for it. Also so far as output is concerned it makes it immaterial as to whether a shop considers an engine receives Class 1 or Class 2 repairs; in either case the shop simply obtains credit for the mileage made since the engine last received repairs of either of these classes.

If this plan is adopted the shop output for any month would therefore be stated somewhat as follows: that a given shop with a certain expenditure of money has turned out say 10 units of machinery repairs, 8,000 flues, four fireboxes, and one boiler. This puts the amount of repairs turned out on a distinct basis irrespective of what class they are, and in the long run will tell not only whether the shop is doing well, but whether the methods employed on that division are good or not.

If this method of dividing output is adopted it would be advisable to put the roundhouse repairs on the same basis, namely their cost per unit of engine ton mile. The engine ton mile is in reality the most accurate unit on which to base cost of repairs. It is practically taking the cost of repairs per mile by classes on the assumption that the cost for each class varies with its weight which, while it may not be actually true, is certainly closer than assuming that the engines of widely different weights cost the same amount for repairs. A statement of the total cost of repairs per unit of engine ton mile would be practically independent of the grades on any division or class of service, since providing engines are loaded to capacity, which can be safely assumed, the work done by them is very closely in direct proportion to the total weight of the engines; in other words an engine of any given weight should cost approximately the same amount to repair per mile, whether employed in passenger or freight service, or on a level or hilly division. If the cost per engine ton mile is known on any division for roundhouse and shop work it would be possible to determine whether that division is doing a greater or less proportion of work in the roundhouses and whether if greater the extra work is compensated for by sufficient decrease in shop cost to produce a smaller total cost and show that it was the better system. It is evident that the proposed system, while simply suggested for machinery repairs as a comparison of output, could be advantageously extended to investigate the relative cost of roundhouse and shop work of various divisions with different proportion of light and heavy engines.

We are strongly impressed with the importance of a unit for judging cost of repairs which enables a comparison to be made of the efficiency of repairs made at shops, regardless of the repairs made at roundhouses.

It is quite probable that the unit of engine ton miles will enable such conclusions to be drawn accurately, but at the same time, with our present lack of experience, it seems probable that the cost of shop repairs to engines per ton would also afford a valuable basis for judging the relative efficiency of shop output; for this reason it seems advisable that for the present at least the cost of general repairs made at shops should be kept on the basis of the ton as well as the basis of the engine ton mile.

The weight of the engines referred to, should be the weight of the engines loaded without tender. The reason for this is that tender repairs cost far less for a given tonnage, than engine repairs do; in fact so far as labor is concerned 100 tons of tender only requires about 10 per cent. of the cost that the 100 tons of engine does. The material item, however, is heavier, so that this would be very closely compensated for by the weight of water in the boiler which can be included in the tonnage.

The second advantage of taking the weight of the engine loaded as a method of measuring tonnage is that the cost per ton mile of engine repaired is obtained and this figure is closely proportional to the work done by the engine when in service, since this work on any division or in any service is, providing the engines are loaded to capacity, which can be safely assumed now-a-days, in direct proportion to the total weight of the engine.

In recapitulation the recommendations are as follows:

First, that to ascertain mileage or duration of service to be expected before requiring further repairs from engines turned out each month from the various shops in order to determine the average condition of power and whether same is improving or deteriorating and to advise mechanical officers not connected with the shop of the general condition of the engines when turned out, that the following classification of repairs be adopted:

Class 1—General repairs to machinery.
Class 2—Light repairs to machinery.
Class EH—Engine house repairs.
Class A—Accident repairs.
Class W—Wreck repairs.

And that letter "F" be suffixed to any of the above classes to indicate flues renewed.

Second—To enable a rough comparison to be made of the output of any shop as compared with other shops or with its previous record, that the expenditure, together with its proper proportion of expenses at each shop on Classes EH, A and W, repairs should be separated from the total expenditure and expenses at that shop and should be considered separately from the regular repair work; and that the expenditure, together with its proper proportion of expenses for manufacturing work and work done for roundhouses, should be separated from total expenses at each shop in each month and be considered separately; the balance of expenditure and expense which may be considered as equivalent to the regular repair output which is to be determined in the following manner:

Third—The flue output is determined by the total number of flues replaced in each month.

Fourth—The output of fireboxes is determined by the total number of firebox sheets renewed, divided by four.

Fifth—The output of boilers is determined by the number of boilers built.

Sixth—The output of machinery repairs is determined by multiplying the loaded weight in tons without tender of each engine turned out, by the mileage it has made since last shopping for Class 1 and Class 2 repairs, and dividing the total of such amounts in each month by 10,000,000 to arrive at the number of units of machinery repairs turned out.

Seventh—That in addition a record be kept of the ton-weight of engines turned out receiving Class 1 and Class 2 repairs.

Eighth—It is advisable that the engine ton-mile basis be extended to roundhouse work in order to indicate whether a greater or less amount of work is done on engines on each division at the roundhouses, and determine the results obtained therefrom both in costs at shop and total cost per engine ton-mile.

By the purchase of the trolley system of street railroads of the city of New Haven, the New York, New Haven & Hartford Railroad adds 110 miles to its electrically operated lines. This gives that system 187 miles of electric lines in Connecticut, or nearly one-third of the total mileage of the electric roads of the State. This purchase is believed to have been made to control the electric railroad situation with respect to preventing a possible through line from New York to Boston by connecting the various trolley roads.

LETTERS TO THE EDITOR.

SUGGESTIONS.

To the Editor:

As a friend of young men, I desire to ask you to print the following hints, which may help some one to be patient while getting started:

"Do not expect a raise in salary every sixty days, but increase your usefulness, and the time will come when you can demand a raise and get it.

"To do a thing well is the first offering on the altar of ambition.

"People who never do any more than they are paid for never are paid for any more than they do.

"Forgetfulness is the cause of many a failure.

"The smart set may be all right, but smartness of the wrong kind destroys your chances with your employer and the public.

"Recognize the fact that the man employing you has some privileges. Let him dictate. You draw your salary and work.

"If you follow out these rules very carefully, you are bound to be a success: Be punctual, be practical, be courteous, be pleasant, be accurate, be thoughtful, be willing, and be hustling.

"Do not despise little things. Remember you must be little before you are big. With bigness comes strength.

"Be pleasant. A kind word or a smile to your associates may secure to you an enduring friend." RETIRED.

NUMBERING SHOP MEN.

To the Editor:

On page 108 of the March issue of the AMERICAN ENGINEER "Foreman" says, "I wish to register a protest and I hope you will put your foot of disapproval down on any system of numbering men as recommended in the article on "Railway Shop Management." I believe this to be the most detestable thing in any shop and will antagonize any intelligent man. Let us devise something to elevate the men instead of lowering them like animals at a county fair."

Now, this is an entirely new feature of the case. It has never occurred to me before that an *intelligent* man would be *antagonized* because he had to call out a number when passing the office of the shop in which he is employed. I had looked upon this as being a rather simple way to give an intelligent man equal opportunity to know that his time was being properly kept.

Of course, I would not want to go before the public with any system of time-keeping and accounting that would include a proposition to "lower men like animals at a county fair," and beg to insure "Foreman" that I am heartily in accord with him in any scheme that will elevate shopmen.

A hollow assertion that certain methods are vicious and antagonistic is not, however, sufficient to induce me to discard a system of numbers; but if "Foreman" has a scheme whereby as good or better results can be obtained than by numbering workmen, and can at the same time show substantial reasons why an intelligent man should be antagonized by calling a number, I think I shall be the first to adopt it.

I suggest here that "Foreman" give in detail what he considers a thorough system of handling the time of railroad shopmen, and also that he sign his name in full and the road by which he is employed.

W. S. COZAD.

RECTANGULAR VS. ROUND ENGINE HOUSES.

To the Editor:

May I profit by the results of your observations abroad to the extent of having your views of the comparative merits of our American roundhouse and accessories, and the rectangular English form served by a transfer table? MECHANICAL ENGINEER.

EDITOR'S NOTE.—English locomotives are usually housed in rectangular "running sheds," which are sometimes served by turntables, and often the turntable is outside. The locomotives stand in long "strings," which are awkward if a locomotive in the middle of a string is wanted in a hurry. American roads should carefully consider the relative advantages of roundhouses and rectangular ones two lines of engines standing on both sides of a transfer table. Where room and track connections permit, it is a question whether it will not pay to build rectangular houses, and provide for turning locomotives on "Y" tracks, or even on turntables outside of the house. During the past severe winter great difficulty has been experienced from fog in roundhouses, due to the frequent opening of a number of doors. A modern house, in which the heating and ventilating system changes the entire volume of air once every fifteen minutes has been a conspicuous offender in this matter, and the fog not only delayed work on the engines, but also caused serious danger of getting engines into the turntable pit when the air was still outside. A plan permitting of reducing the number of doors to one appears to be very attractive, in the light of this experience. Also the matter of crane service in a rectangular house is worth considering. Anything which tends to improve locomotive terminals and to facilitate prompt movement of locomotives between runs is worth a reasonable amount of increased cost.

A SUGGESTION IN CRANES.

To the Editor:

Under ordinary conditions in the up-to-date longitudinal locomotive shop with its two sixty-ton overhead traveling cranes, one of these cranes is usually in the boiler shop, leaving the other to serve the erecting floor, except when engines are to be lifted or traversed across the shop. Furthermore, the sixty ton crane is very heavy, and weighs probably not less than fifty-five tons, and is made for heavy work. In every erecting shop there is a great deal of light lifting; setting a stack, an arch front, a cab, an air pump, etc. For this purpose it would seem that a light electric traveling bracket crane over each side track would be of considerable value, and would avoid many unnecessary waitings, which would otherwise occur when the large crane was busy. Its capacity need not exceed 5,000 lbs., its speed might be high. In a very large shop an operating cage could be provided; otherwise, it could be operated from the floor by cords. A crane of this kind would probably weigh not more than 10,000 lbs. It would not be a tax of much consequence to the power plant, and the added cost to the building on account of the runs or girders would be a very nominal figure.

To provide for such a crane the operator's cage of the large cranes should be in the center of the bridge. But this gives the operator a better command of the floor. If the cages are hung from the outside of the bridge and opposite each other, as I have shown in the accompanying sketch, Fig. 2, an engine will swing between them. Figure 1 shows a half lateral section of such an erecting shop with an engine suspended to show clearances. Fig. 2 is a diagram showing the location of the operator's cages on the sixty ton cranes, and the clearances between a suspended engine and the operator's cages.

L. S. & M. S. Ry., Cleveland, Ohio. MALCOLM HARD.

LOCOMOTIVE FAILURES IN ENGLAND.

To the Editor:

I noticed in the March number of the AMERICAN ENGINEER a statement to the effect that engine failures are regarded as unpardonable sins on English railways, and hence infer that they have very few failures. If this is the case, I should like to know how, in your opinion, they accomplish such results? Is the design of their engines better, or do they get better care, or are the trains enough lighter that their freedom from engine failures can be accounted for in this way?

SUPERINTENDENT OF MOTIVE POWER.

EDITOR'S NOTE.—English locomotives are most carefully designed in all their details. They are better cared for than ours. They are not required to do unreasonable service, and their mileage is not so great as to preclude proper running repairs. The adjustment of the brick arch, deflector over the fire-door, and the front-end appliances, is the work of weeks or months in the case of every new class of engine turned out. The boilers, while small, make plenty of steam without burning up the tubes and sheets, and the locomotive superintendents have sufficient authority to keep their equipment in the best possible condition; in fact, they are required to do so, and the connection between the locomotive department and the stock market is less direct than it is in this country. Further discussion of this subject will be found elsewhere in this issue.

A bill was introduced in the House of Representatives March 3 by Mr. Esch, the purpose of which is to compel railroads to build no passenger equipment cars after January 1, 1906, without steel side and end sills and at least four other steel longitudinal sills extending from end to end of the car, including platforms. The bill also requires steel vestibule and body frames. It was referred to the Committee on Interstate and Foreign Commerce.

BOILER SHOP TOOLS.

ATCHISON, TOPEKA & SANTA FE RAILWAY.

Before Mr. G. R. Hendrson severed his connection with this road as superintendent of motive power, he sent us a copy of a systematic set of rules for boiler work, put into force by him for use of the mechanical superintendents and master mechanics. The rules include lists of equipment for the guidance of mechanical superintendents and master mechanics in ordering the small portable tools and in making recomendations for large machine tools when they are considered necessary. It is not intended that all shops in the several classes shall be equipped with all the machinery in this list, but that when tools are ordered they shall be selected from these.

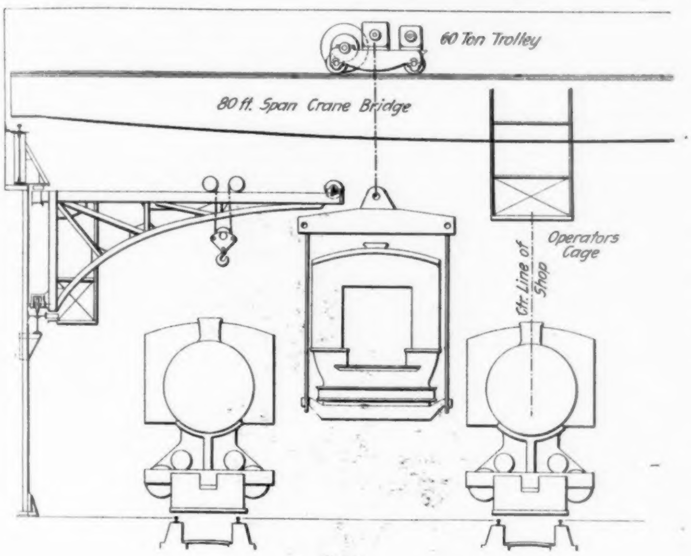


Fig. I.

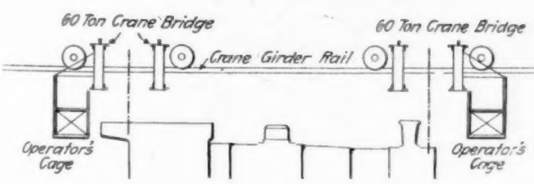


Fig. 2.

A SUGGESTION IN SHOP CRANES.

BOILER SHOP EQUIPMENT FOR DIVISION SHOPS.

With reference to boiler work tools, division shops are divided into three classes according to the work for which they are equipped, and the number of engines cared for. Class A shops do flue setting, light patching, tank repairs, ash pan, grate repairs, etc., for about thirty-five engines. Class B shops do the same as Class A, and in addition renew crown sheets, flue and door sheets, and do general repairs, caring for about seventy-five engines. Class C shops do the same as Class B, and in addition renew fireboxes and do all kinds of general boiler work except building new boilers; the number cared for in this class of shops is about 150.

Class A Boiler Shop Equipment.

Hand punch and shears, for punching 13-16-in. holes in ⅜-in. plate, 20-in. gap, and for shearing ⅜-in. plate.
Hand or power rolls for ⅜-in. plate, 42 ins. between housings.
Small pair of clamps.
Power flue cutter.
Drill press.
Air drill, No. 2 reversible.
Two chipping and caulking hammers, 1 1-16-in. piston, 3-in. stroke.
Taps.
Flue rolls.
Sectional expanders with octagonal pin.
Riveting hammers (hand).
Sledges.
Blower.

Class B Boiler Shop Equipment.

Power punch and shears for punching 1-in. holes in ¾-in. plates, 36-in. gap, and for shearing ⅝-in. plate.
Radial drill, 5 ft. radius, for drilling 3½-in. holes in flue sheet.
Power rolls ¾-in. plate, 10 ft. between housings.
Hand or power rolls ⅜-in. plate, 42 ins. between housings.
Pair of clamps, 10 ft.
Flange forge.
Hertz flue welder.
Flue rattler, 54 ins. diameter, 20 ft. long.
Flue welding oil furnace.
Flue cutter.
Emery wheel.
Staybolt threading machine.
Air drill, No. 2 reversible.
Two air drills, No. 11, reversible, with angle attachment.
Long stroke riveting hammer, No. 80.
Four chipping and caulking hammers, 1 1-16-in. piston, 3-in. stroke.
One pneumatic flue cutter.
Taps.
Flue rolls.
Sectional expanders with octagonal pin.
Riveting hammers (hand).
Sledges.
Blower.

Class C Boiler Shop Equipment.

One power punch and shears for punching 1¼-in. holes in 1⅛-in. plate, 54-in. gap, and for shearing 1-in. plate.
One power punch and shears, for punching 1-in. holes in ¾-in. plate, 42-in. gap, and for shearing ⅝-in. plate.
One power punch for punching ⅝-in. holes in ⅜-in. plate.
One power bevel shears, for ⅝-in. plate.
One power angle iron shears for 4-in. x 4-in. x ¾-in. angles.
One plate planer for long plates.
One power rolls to roll 1⅛-in. plate, 12 ft. 6 ins. between housings.
One hand or power rolls to roll ⅜-in. plate, 42 ins. between housings.
One power stationary riveter, for 1¼-in. rivets, 12-ft. 6-in. gap.
One radial drill press, 7-ft. radius, for 4-in. holes.
Two radial drill presses, 5-ft. radius.
One small lever drill press for light work.
One triple-head staybolt threading machine.
One double-head staybolt threading machine.
One Hertz flue welder.
One flue rattler, 54 ins. x 20 ft.
Two flue cutters.
Two flue welding oil furnaces.
One emery wheel.
One pneumatic swager.
Two pneumatic punches.
One pair pneumatic clamps, 12 ft. 6 ins.
One flange forge.
One annealing furnace.
One flange punch, 1-in. hole in ⅞-in. plate.
One staybolt clipper.
One staybolt breaker.
One tank riveter.
One truck riveter.
Three oil furnaces for rivets.
One oil separator.
One safe end scarfing machine.
Two air drills, No. 2 reversible.
Four air drills, No. 11 reversible with angle attachment.
Two long stroke riveting hammers, No. 80.
Six chipping and caulking hammers, 1 1-16-in. piston, 3-in. stroke.
Two pneumatic flue cutters with motors.
Taps.
Flue rolls.
Sectional expanders with octagonal pin.
Riveting hammers (hand).
Sledges.
One blower.

Mr. J. R. Slack has been appointed assistant general superintendent of the Delaware & Hudson. Mr. Slack was mechanical engineer of the New York Central and later of the Central Railroad of New Jersey. For the past two years he has been superintendent of motive power of the Delaware & Hudson and is succeeded in that position by Mr. J. H. Manning, recently resigned as second assistant superintendent of rolling stock of the Canadian Pacific.

THE CORRINGTON AIR BRAKE.

This system combines automatic and straight air apparatus in such a way as to maintain each at all times independent of the other, so that while operating one the other may be brought into action if desired. The objects are: (1) to provide continuous control of passenger or freight trains; (2) to render it possible to make smooth stops with a minimum expenditure of air; (3) to avoid the parting of trains and increase the safety on grades by providing apparatus permitting the engineer to release the automatic brakes on the train and retain straight air on the engine while recharging; (4) to render the pumps and reservoirs of both engines available in double-heading; (5) to render it possible for either engineer to control the train and permit either engineer to release his engine brakes in case the tires are heating.

These features are combined in a new consolidated engineer's valve, substituted for the existing valve on the engine, and, in fact, all of the apparatus is made interchangeable with that of existing systems. This company has a triple valve venting the train pipe into the atmosphere in emergency applications, a new form of high-speed reducing valve and other devices. The most important is the new engineer's valve, which concentrates a large number of functions into a single device and is designed to give the engineer less rather than more to think about in handling his brakes. This system does away with the necessity for retainers on the cars.

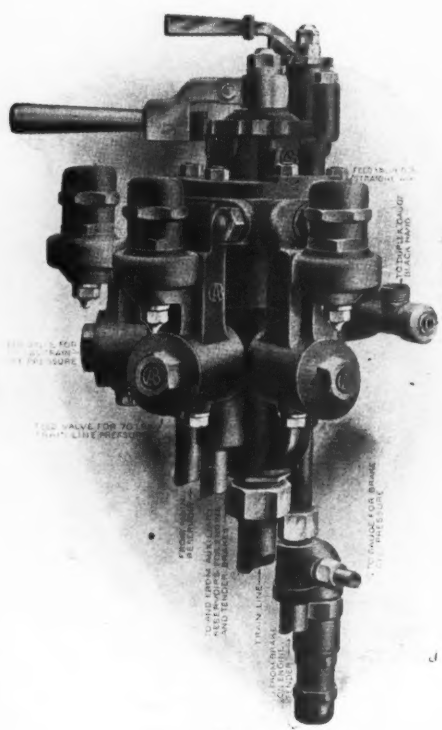


FIG. 1.

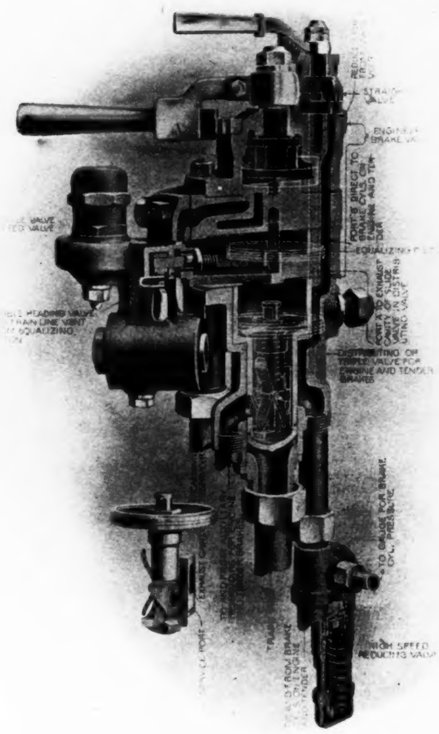


FIG. 2.

There is but one way to properly study a brake system, and that is to inspect the apparatus as arranged in an exhibit specially installed in connection with a rack of car equipments. A general description of the consolidated valve, however, is presented by aid of the accompanying engravings.

It will be noted by reference to Figs. 1, 2 and 3 that the consolidated engineer's valve includes, in one device, the brake valve, with operating handle, rotary valve, equalizing piston and feed valves; a triple valve, with piston, graduating valve and slide valve; an automatic high-speed reducing valve and a straight air valve, with operating handle, rotary valve and slide valve feed valve, and that the whole is a combination of well-known and thoroughly tested devices.

In the engineer's valve an additional feed valve and running position of the handle is provided, permitting the use of two train line pressures and the possibility of using either according to the position of the operating handle, making unnecessary the use of the present reversing cock, two feed valves and pipe bracket. The positions and directions of movement of handle for full release, running, service, lap or emergency, with the exception of the position for the extra feed valve mentioned, are precisely the same as in valves of the Westinghouse type. The method of operating the equalizing piston with train line air also differs from, but is precisely equal in efficiency and time to the existing type, and owing to the design of the port leading to the under side of this piston, as shown in Figs. 2 and 3, will not open after an emergency application or a heavy train line reduction when the handle of the brake valve is moved to full release position.

Owing to a special arrangement of ports train line pressure is indicated by the black hand of the duplex gauge when the handle of the brake valve is on lap position.

Referring to Figs. 2 and 3, it will be obvious, excepting for the adjustments of design to suit the triple portion of the consolidated engineer's valve, that main reservoir air has access to, and the train line air from and to, the brake valve in the usual manner. For convenience in double-heading, and in order that the automatic features of the brake may be absolutely maintained on the second engine, a small rotary valve is provided at the termination of the outlet of the train line from the equalizing piston. For double-heading it is only necessary to close this valve and place the handle of the brake valve on lap, leaving the triple portion of the consolidated engineer's valve operative from the first engine precisely as though the second engine and tender were a car forming a portion of the train.

While the sequence of operation is precisely similar to the best valves of similar types, owing to design and arrangement of ports and passages, the time required for release and recharge, with the handle in full release position, has been very materially reduced, and this is also true concerning the running position, owing to the size and arrangement of ports and the construction of the slide valve feed valve.

The triple valve portion of the consolidated engineer's valve is identical in principle with plain triples now in use, and it is operated by a reduction or increase in train line pressure through the ports and passages connecting with cylinder and train line, as shown in Figs. 2 and 3. The size of the ports in the slide valve, and in the slide valve bushing, is such as to accommodate in one triple valve the full requirements of the brake cylinders on engine and tender, and in result equal

to that obtained by the two triples at present used. The piston, slide valve and graduating valve, as shown in detail in Fig. 2, perform the usual functions, admitting air to the brake and exhausting the brake cylinder pressure to the atmosphere through the cavity in the slide valve, the port A and the straight air valve when in release or normal position, as shown in Figs. 2 and 3. The feed groove for recharging is of sufficient capacity, within the proper time, to recharge the auxiliary reservoirs for the engine and tender brake cylinders, but not sufficiently rapidly to cause a reapplication of the brakes on the engine and tender. For compactness, the graduating stem and spring for use in emergency application is included in the triple piston. The main reservoir, train line, equalizing reservoir and gauge connections, as well as all other pipe connections, are for convenience of cleaning and making repairs, made directly to the triple valve body, making it unnecessary to break any pipe connection for the removal of any portion of the consolidated engineer's valve, and the dimensions from the stud to any of these unions or connections are precisely the same in all respects as the present Westinghouse type of brake valve. Two ¾-inch pipe connections are made to this triple, one leading to the auxiliary reservoirs on the engine, and the other to the brake cylinders on the engine and tender, the latter containing a special fitting for the automatic high-speed valve and gauge connection for brake cylinder pressures.

FIG. 3.

Referring to Figs. 1, 2, and 3 it will be noted that the straight air portion of the consolidated engineer's valve constructively forms a part of the cap, enclosing the rotary valve and key which is enclosed or covered by a separate cap held in place by two studs. This cap is provided with an index plate containing notches indicating the release, normal, lap and service positions of the operating handle, the relative location of this handle to the brake valve handle being such as to afford easy and prompt operation of either by the engineer with one hand, and without interference.

Referring to Fig. 4, the openings constituting port A, port B, and the exhaust to the atmosphere, are shown in the seat of the straight air rotary valve, the port A being the termination of a direct connection of the exhaust port from the triple valve, and the port B the termination of a direct connection to the triple valve, and the port B the termination of a direct connection to the brake cylinders and service port of the triple valve, as indicated in Fig. 2 in dotted lines and full section respectively. The additional ports shown in Fig. 4, and not specially indicated, and connecting with the cavity in the seat, are provided for the purpose of securing additional area of opening and avoiding excessive movement of the valve. A fourth, or reduced main reservoir air port is provided, being the termination of the reduced main reservoir air passage leading from the special slide valve feed valve, to which main reservoir pressure is supplied from the cap enclosing the rotary valve of tne brake valve and through the port C as indicated.

In the release position of the straight air valve both ports A and B are open to the atmosphere. In normal position the port A and the exhaust of the triple are open to the atmosphere. In the lap position all ports are closed. In the service position the reduced main reservoir pressure is admitted into B leading to the brake cylinders. In release position of the handle a warning or alarm port is also opened as a suggestion for returning the valve to the normal position. The normal or release position of the handle of the straight air valve corresponds to what might be termed a running position, and in this position provides a continuous and free outlet to the atmosphere of port A from the exhaust cavity of the slide valve and port of the triple. The necessity for rapid transmission of air to, and exhaust from the brake cylinders, where straight air is used for switching service, has been anticipated in the areas of ports A and B, both of which form a continuous passage from the brake cylinders when the automatic is not in use, and according to position of straight air valve handle, reducing the time in which this is accomplished by other forms of apparatus.

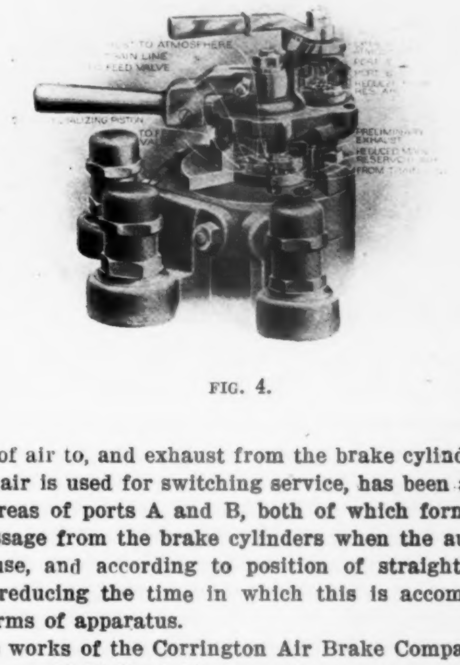


FIG. 4.

At the works of the Corrington Air Brake Company at Matteawan, near Fishkill, N. Y., the entire apparatus may be seen in connection with equipments of a 50-car train and chronograph recording devices for studying the action of the brakes.

The importance of the utilization of waste products of manufacturing and metallurgical operations was emphasized some time ago by Mr. Maw in his James Forrest lecture before the Institution of Civil Engineers (England) when he said: "It has been stated by Messrs. Cochrane, as a result of their experience, that the gases from a blast-furnace making 120 tons of Cleveland iron per day are capable, if utilized in a gas-engine, of developing 4,500 h.p. continuously. This corresponds to 37½ h.p. developed continuously for each ton of iron produced per day. Of course, the value of blast-furnace gases for power purposes will vary with the class of ore smelted and other circumstances; but even if we reduce the power available to 30 h.p. per ton of iron made per day, then with our British output of over 20,000 tons of pig-iron per day, we get 600,000 h.p. as capable of being generated continuously by the utilization of our blast-furnace gases, these gases thus replacing a consumption of, say, between 4 and 5 millions of tons of coal per annum."

MOTOR-DRIVEN MACHINE TOOLS.

RECENT TENDENCIES IN INDIVIDUAL LATHE DRIVING.

The important developments that are being made in motor driving, as applied to machine tools, attest the increasing popularity of this mode of machine driving. It is not uncommon now to find shops in which it is difficult to find traces of the former methods of driving machines by overhead belts. The inevitable difficulties and drawbacks of the motor-drive have been revealed by experience and are being provided for, and standard designs for motor-driving applications are being worked out by the tool builders.

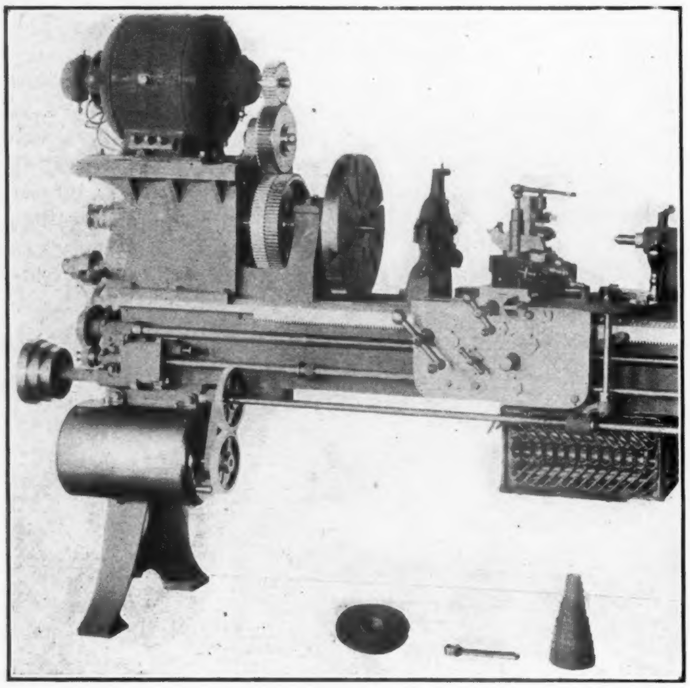


FIG. 1.—GEARED HEADSTOCK DRIVE UPON A 16-INCH BLAISDELL LATHE.— 2 H. P. BROWNING VARIABLE-SPEED MOTOR.

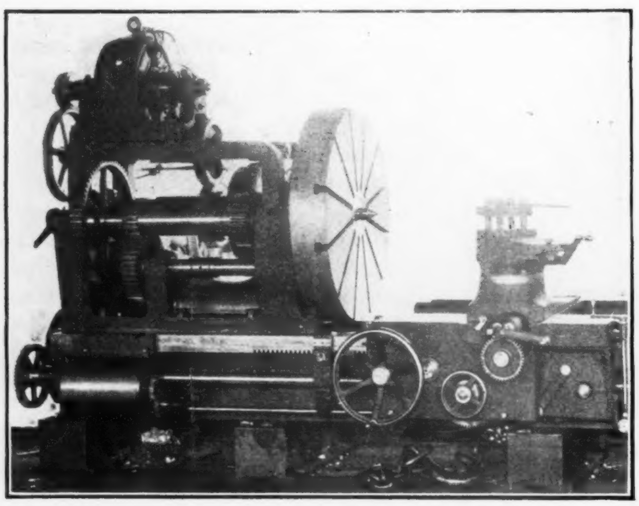


FIG. 2.—GEARED HEADSTOCK DRIVE UPON A 48-INCH POND LATHE.— 15 H. P. WESTINGHOUSE MOTOR ARRANGED FOR VARIABLE-SPEEDS.

As an example of the development of standard designs, attention should be called to the case of motor application that was made to the Jones & Lamson flat-turret lathe at the old shops of the Pittsburgh & Lake Erie, for use at their new shops at McKees Rocks, as described on page 89 of the March issue by Mr. R. V. Wright in his series on, "The Application of Individual Motor Drives to Old Tools," part VIII. It was very interesting to note that the Jones & Lamson Machine Company had anticipated the demand for motor driving on their standard designs of turret lathes and had designed a special single-piece motor-support bracket that can be bolted to the headstock of any one of their lathes for carrying the driving motor, as illustrated in detail in the above-mentioned article. This arrangement of drive proved very neat and to be the easiest possible method of adapting the standard type of tool to the individual drive, and indicates the appreciation of the tool builder of the importance of motor driving.

A neat arrangement of motor driving for a lathe has recently been developed by P. Blaisdell & Co., Worcester, Mass., as indicated in the view, Fig. 1. This shows a 16-inch Blaisdell screw-cutting engine lathe, which has been equipped with a 2-H.P. Browning direct-current variable-speed motor. The motor is neatly and conveniently supported by a cast-iron bracket, bolted above the headstock and occupying the usual position of a cone pulley, which is omitted; the drive is carried direct to the spindle by gearing through an intermediate idler pinion, which is of rawhide to reduce noise.

A wide range of speed changes is afforded in this drive by

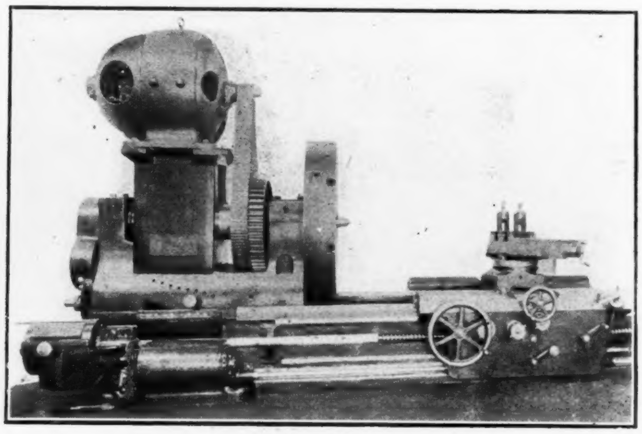


FIG. 3.—SILENT CHAIN HEADSTOCK DRIVE UPON A LODGE AND SHIPLEY LATHE.—CROCKER-WHEELER VARIABLE-SPEED MOTOR.

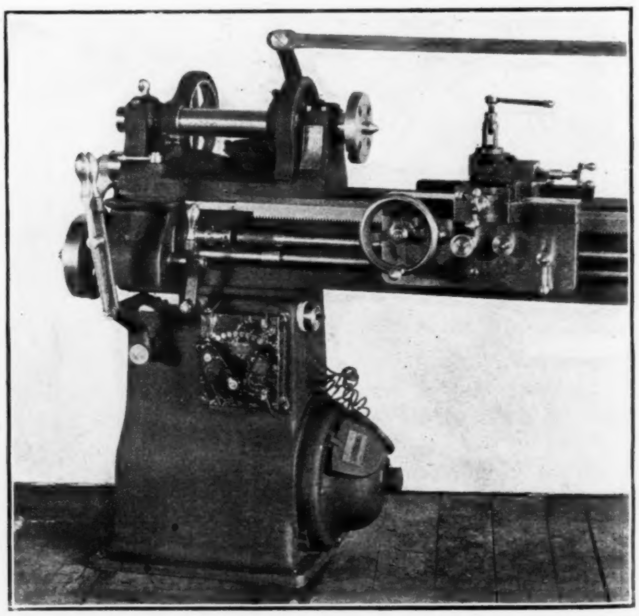


FIG. 4.—INTERESTING NEW DESIGN OF GEARED VARIABLE SPEED, ENCLOSED DRIVE FOR A LATHE WITH CONSTANT SPEED MOTOR.— FLATHER & COMPANY.

means of the controller, shown beneath the headstock, which is conveniently operated from the lathe's carriage; the controller handle on the apron turns the splined shaft running lengthwise beneath, and this operates the controller through gearing. The resistance box necessary with the controller is placed out of the way beneath the bed, and is protected from short-circuiting troubles by a cover pan.

This is unquestionably a most excellent arrangement of motor application for individual driving. It is especially commendable as it is applicable to standard types of lathes with-

out alteration of their design and the expense of the motor application is thus greatly reduced—this feature, the original cost of applying the drive to a machine tool, has been a great drawback to the general adoption of electrical driving methods.

Fig. 2 illustrates a very similar arrangement of motor driving as applied to a large 48-inch engine lathe, built by the Pond Machine Tool Company. In this case, also the motor is supported above the headstock, but here a skeleton frame is used to support the motor, which spans across the headstock bearings and leaves the headstock gearing open and unobstructed. In place of the usual cone pulley a special gearing arrangement is provided at the spindle by means of which six changes of speed may be obtained through slip and back gears. The motor drives the spindle gear through a reduction gearing equipped with rawhide pinions for smooth running.

The motor used upon this lathe is a 15-H.P. Westinghouse direct-current variable-speed motor, operated by field-control through a controller. The controller is located upon the bed beneath the headstock, and is manipulated directly from the

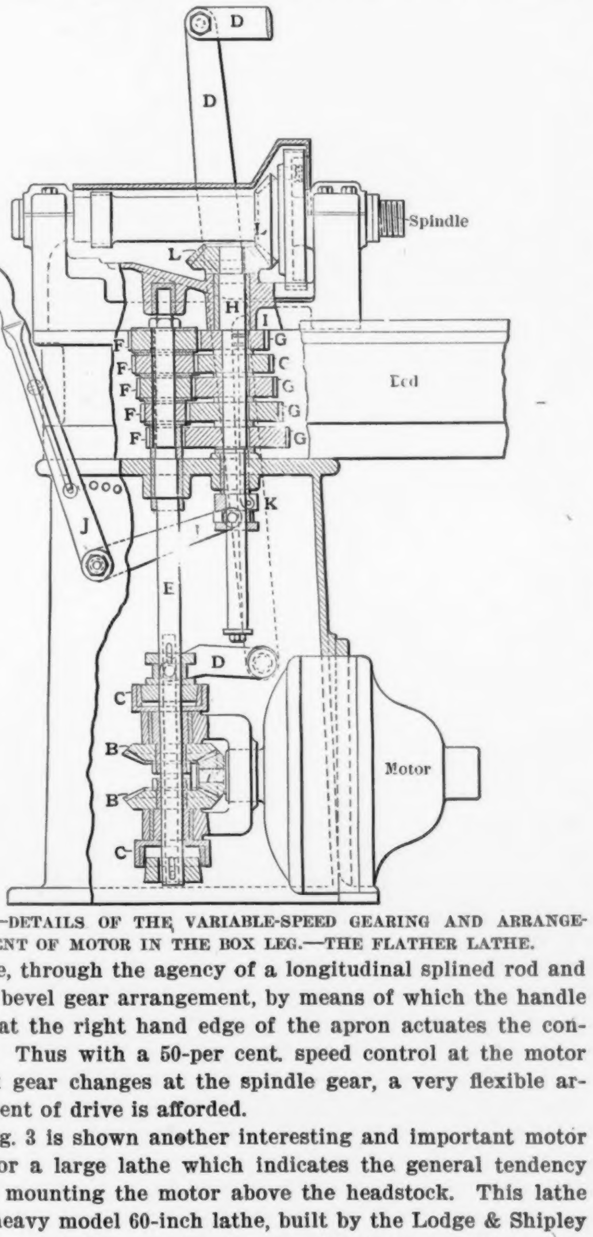


FIG. 5.—DETAILS OF THE VARIABLE-SPEED GEARING AND ARRANGEMENT OF MOTOR IN THE BOX LEG.—THE FLATHER LATHE.

carriage, through the agency of a longitudinal splined rod and sliding bevel gear arrangement, by means of which the handle shown at the right hand edge of the apron actuates the controller. Thus with a 50-per cent. speed control at the motor and six gear changes at the spindle gear, a very flexible arrangement of drive is afforded.

In Fig. 3 is shown another interesting and important motor drive for a large lathe which indicates the general tendency toward mounting the motor above the headstock. This lathe is the heavy model 60-inch lathe, built by the Lodge & Shipley Machine Tool Co., Cincinnati, O., with their special type of headstock and spindle for motor driving. In regard to motor supporting bracket this design resembles that of the application shown in Fig. 1, but here the motor drives through a silent chain. The other features of the drive are very similar to those of the Blaisdell motor-driven lathe, shown in Fig. 1. The motor here used is a 20-H.P. Crocker-Wheeler motor, operating at variable-speeds by the multiple-voltage system; the controller, which is in this case also located in front of the headstock and operated from the carriage, is the standard Crocker-Wheeler multiple-voltage controller by which a 3 to 1 speed range is afforded at the motor.

In Fig. 4 is illustrated a new and radically different design of motor driving for lathes, which is of great importance, as it involves some features which may meet with general adoption for lathe driving. It was designed and built by Flather & Company, Nashua, N. H., and is shown in Figs. 4 and 5 as applied to a 14-inch Flather engine lathe. The neatness and compactness of this drive, as well as its great convenience of operation, have drawn marked attention to it from all sides, and it is worthy of careful attention as being one of the first instances of a lathe designed especially for and made a standard for motor driving.

The motor is, in this arrangement of driving, placed in a box leg beneath the headstock. While in the present case it is shown on the right hand side of the leg, it can be placed at the left, or arranged otherwise equally as well. When placed as shown in this view, a plate is cast in the bed to protect the motor from chips and dirt falling upon it and doing harm; the body of the motor is held firmly in place by means of lugs fastened to it and in turn screwed to the leg, while the inner end fits into a hole bored in the cross ties cast in the leg.

The details of the drive are clearly shown in the sectional view of the headstock and box leg, Fig. 5. On the end of the armature shaft is a rawhide pinion, A, meshing with metal bevel gears, B-B, turning them in opposite directions. These gears are keyed to the friction clutches, C-C, and are connected to either, or disconnected, at will, by the lever D; this lever, which starts, stops and reverses the lathe, has an extension handle running the full length of the bed and is convenient at all times to the operator.

On the upper end of shaft, E, are keyed five metal-flanged rawhide-gears of different diameters, which mesh with five corresponding gears running loosely on shaft, H. These gears are connected to shaft, H, one only at a time, by means of key I, which slides in a keyway cut in the shaft; when this key, I, is moved from gear to gear by means of lever, J, it is depressed flush with the shaft by the collars placed between the gears, G-G. By this means the key must be entirely out of one gear before the springs placed under the key can force it into the keyway in another gear; hence there is absolutely no way by which more than one gear at a time can be connected to the shaft H. On the upper end of shaft H is a bevel gear, L, meshing with a similar gear on the lathe spindle where the cone is usually placed. The back gear is retained and operated as usual.

The lever, J, is very convenient for the operator and can be moved for varying the speed while the lathe is running, giving a quick change instantly, with practically no shock or jar; the starting, stopping and reversal of the drive is most conveniently provided for by the extension handle, D. The lathe has been so designed that nearly any make, speed or style of motor, either direct or alternating current, can be used and thus meet the needs of any class of service. The motor can be removed for inspection without disturbing any other part. The bevel gears have planed teeth which tends to reduce the noise to a minimum, while placing the motor in this way as low as possible, prevents any swaying or vibration.

As above stated, this design of motor driving merits careful attention of those interested in this important subject, as it accomplishes several important things that the other styles of drive do not. In the first place, the motor is unobtrusively placed below the bed in an unoccupied space, which not only eliminates the possibility of vibration, but also leaves the headstock free and open for inspection and care; in the second place, the drive is thus made enclosed and entirely protected, and instead of losing in convenience of operation its flexibility is greatly increased—and without undue complication. The objection that has been offered to this arrangement of driving, that only certain types of motors may be used is useless, as it can easily be arranged for any modern enclosed-type of motor, whether for direct or alternating current. This design is indeed an important innovation in the field of motor driving and offers many new ideas.

THE CARD INDEX IN THE DRAFTING ROOM.

BY J. H. LONIE.

The card index system now occupies an established place in commercial and professional offices. One of the places where it can be employed to the best advantage is the railroad draughting room. Much valuable time is often unnecessarily wasted in searching for drawings or prints which, were they properly indexed, could be located in a few minutes. The card index system, by reason of its simplicity, accessibility and expansibility, is especially adapted to this work. It will be found impossible to so apportion a series of numbers in a book that each drawing will be listed in its proper place, while in the card system they may always be listed in alphabetical order.

An outfit for this work may be purchased from any stationery dealer. As many persons will handle these cards it is desirable to have some form of locking device to avoid the danger of a spill. A tinted card is preferable to a white one,

FRAME, TENDER.

1352—G	Class 7, 7 B
1377—G	Class 24 A, 25 A, 25 B, 25 E
1750—G	Steel, 33-in. wheels
1357—G	Class 25 A, 25 B, 25 C
Cancelled	See 1743—G

as it is not so easily soiled by constant handling. Any desired size of card may be used. In the drawing room of the road with which the writer is connected (the Chicago, Rock Island & Pacific), a plain card 4 by 6 ins., perforated at the bottom for the locking rod, is used. If the office typewriter is equipped with a card writing attachment these cards may all be written upon it and a very neat record be made. Each drawing may be listed on a separate card or several drawings of the same part for different classes of cars or locomotives may be listed on the same card. The latter method has the advantage that it keeps the index more compact, but not more than six or eight drawing numbers should be placed on one card. If the latter method is used a space should always be left between lines upon which to enter any additional information relative to the drawing. If it is cancelled, for example, this information should be entered upon the card, together with a reference to the new drawing. It will often be found

1434—C.

Party.	Date.	Party.	Date.	Party.	Date.
G. Hess	1-14-03				
A. E. McL.	1-22-03				
J. B. K.	2-2-03				
J. B. K.	2-4-03				
A. McC.	2-7-03				
C. W. Larner ...	2-17-03				

necessary or advisable to list a drawing showing several pieces, under two or more heads. In that case a letter or letters showing under what additional heads the number may be found should follow the title. This will aid very materially in making records of cancellation, etc. In general it is desirable, for simplicity, to have the drawing number appear on as few cards as possible, but a liberal use of cross cards is recommended. Many parts of cars and locomotives are known by different names and it is not desirable to list these parts for each class under all these heads. Here again the cross card comes to the rescue. Take, for instance, the "fountain" of a locomotive. This is known as the "steam stand," "piano box," etc. This may be indexed under one head as "Fountain" and cross cards reading "Steam Stand," see "Fountain," etc., be made out and filed in their proper order. No definite rule can be given regarding headings, but, in general, the noun should govern. As an example, driving axles, engine and tender truck axles, etc., should all be indexed under Axles, and cross cards may be filed under D, E, etc. If only one person were to use the index an extended use of cross cards would not be necessary, but it must be borne in mind that every person in the office will have occasion to consult it.

If the cards for engine, car and miscellaneous drawings, foreign prints, etc., are all filed together it will be necessary to go through a considerable number to find the one sought. A better plan is to have a drawer for each. Guides (i. e., heavier cards with a part projecting above the common ones) should be used, not only for the alphabet, but for subjects as well. These will save considerable time, as by their use it will be necessary to go through only a few cards each time a drawing is wanted.

The card system can be applied with equal facility to the keeping of pattern and blue print records. Patterns are indexed in the same manner as the drawings, with the exception that in addition to the pattern number the number of the drawing on which it is shown, if any exists, is also given. For the blue print record a ruled card is used. At the top is placed the drawing number. The initials of the party to whom the print is sent appear in the first column and the date in the second. If receipts are required for prints the date of the receipt may be placed in the first column under the first date, or in a third column, as preferred. These cards may be used on both sides. They show at a glance a complete record of all prints made from a drawing.

Closely allied with the subject of indexing is that of numbering and filing drawings. It will be found difficult, if not impossible, to so assign a series of numbers that the series will be properly filled. Either not enough numbers will be assigned or many vacant spaces will be left. In the former case it will be necessary to assign a new series or to start the series over again, using a letter either before or after the number. This is likely to lead to confusion, as there will be two or more drawings of the same number distinguished in the index only by the letter. One of the simplest systems is to number drawings consecutively as made, regardless of size or subject. The sizes may be designated as "A," "B," "C," etc., and the letter added or prefixed to the number. All drawings of the same size are then filed in numerical order in a shallow drawer or drawers suitably arranged and marked on the outside with the size and inclusive numbers. The compartments may also have the inclusive numbers conspicuously placed upon them. With this system no reference need be made in the index to drawers and compartments or set numbers, and if at any time a change is made in the filing no change whatever need be made in the index.

By a conclusive vote the American Society of Civil Engineers has declined to join the other engineering societies in the union engineering building made possible by the generosity of Mr. Carnegie. This action stamps this society as exclusive, fearing the loss of prestige by contact with equally important organizations by uniting in establishing quarters in the same building. Notwithstanding the disappointing result of the vote the union engineering building will still be the center of engineering of this country.

In the equalization of 2-6-2, or Prairie type locomotives it has been discovered that difficulties have, in certain cases developed. In certain cases it has been found that derailments of the forward drivers have occured when these drivers and the leading truck have been equalized together and the two rear pairs of drivers and the trailing wheels have formed the other unit. By changing the hanging so that the front truck and the first two pairs of drivers are in one group with the rear drivers and trailers in another, the difficulty has been removed. This suggests the advisability of careful study of the equalization of this type.

A LOCOMOTIVE WHEEL LATHE RECORD.

A VERY EFFICIENT PERFORMANCE.

One lathe in the shops of the Chicago & Great Western Railway turns all of the tires of all of the engines in service on that road, and the performance is so efficient that Mr. Van Alstyne, superintendent of motive power, has been asked to supply the information for the readers of this journal.

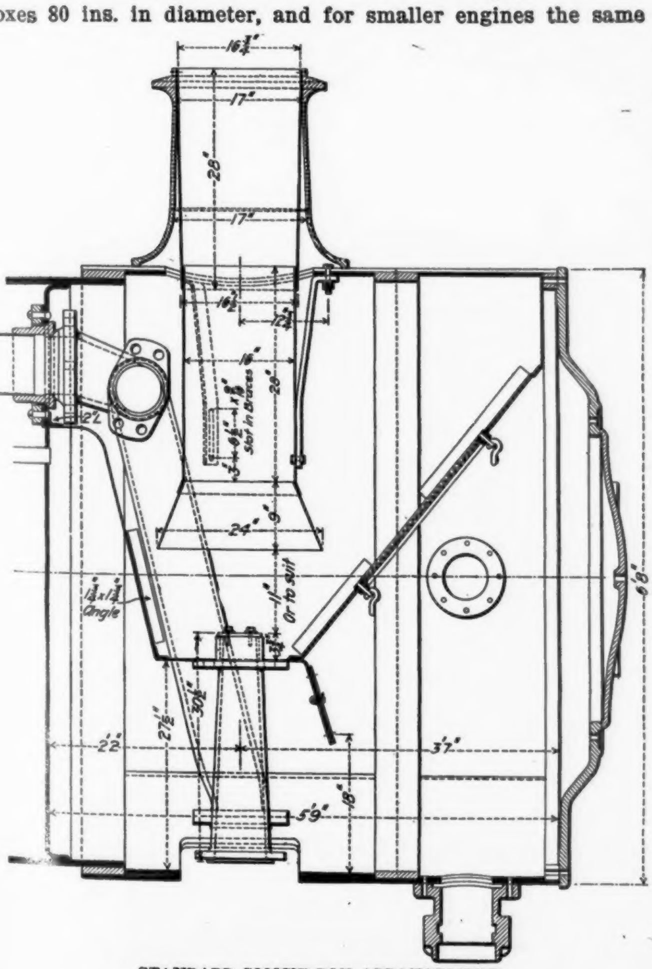
This lathe maintains the tires on 287 locomotives, or 768 pairs of tires, which made in 1893, 8,385,354 miles. It is an 84-in. Niles, double-head wheel lathe, and the cutting speed varies, according to the tires, from 25 to 30 ft. per minute. With Novo and Allen tool steel the cuts are ⅜ in. deep and the feed is 3-32 in. These tires are of the Standard, Midvale and Latrobe makes, and the work regularly turned out averages three pairs of tires per day, with 56-in. centers. The power required is about 15 horsepower.

If others can show records which equal or surpass this, space will be gladly found in this journal to record the facts.

STANDARD SMOKE BOX ARRANGEMENT.

SOUTHERN RAILWAY.

A standard arrangement of smoke boxes on 22 by 30 ins. locomotives of the 2-8-0 (consolidation) type on the Southern Railway is illustrated in the accompanying drawing recently received from Mr. S. Higgins, mechanical superintendent of that road. This arrangement is shown as adapted to smoke boxes 80 ins. in diameter, and for smaller engines the same

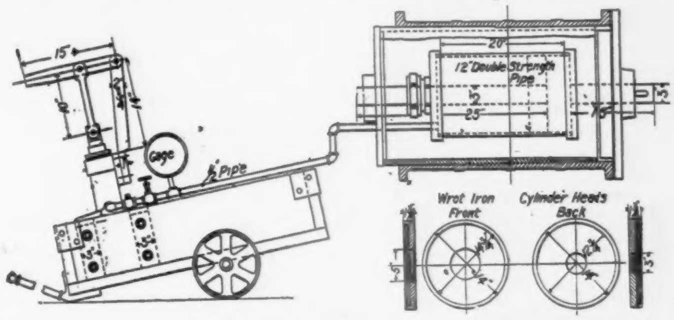


STANDARD SMOKE BOX ARRANGEMENT.
SOUTHERN RAILWAY.

plan is followed, but is modified for the smaller diameters. The diaphragm plate is in front of the nozzle and the stack is extended down into the smoke box by an adjustable pipe terminating about 11 ins. above the nozzle. The drawing shows the arrangement of a front end which is 69 ins. long and a double nozzle 30½ ins. high.

HYDRAULIC PRESS FOR CYLINDER BUSHINGS.

A sketch of a convenient, portable, hydraulic press for drawing cylinder bushings into place has been received from Mr. R. D. Smith, superintendent motive power of the Burlington & Missouri River Railroad. It is in use in all the locomotive shops on that road and is found to be infinitely more satisfactory and convenient than the crude methods of expanding the cylinder by inserting a red hot billet. In the first place, a hot chunk of metal is inconvenient to handle, several men are usually waiting about for it to heat up, the cylinder is always expanded in such a way as to distort its shape, and the process of inserting a bushing partakes of the character of



PORTABLE HYDRAULIC PRESS FOR CYLINDER BUSHINGS.

the job of shrinking jackets on modern ordnance. The troubles are all avoided by the use of this press, which may be wheeled to the engine in the shop or roundhouse. The pulling cylinder is inserted in the cylinder of the locomotive, the bushing is placed in position, the pipes being connected and the keys driven in the piston rod and the pump started. Water for the pump is carried in the tank on which the pump is mounted and the cylinder goes into place without the least trouble. The accompanying engraving shows the bushing when nearly "home" in the locomotive cylinder. All the material may be picked up in any shop and the practice of bushing cylinders is now so common as to warrant the construction of similar devices for use in all shops and roundhouses.

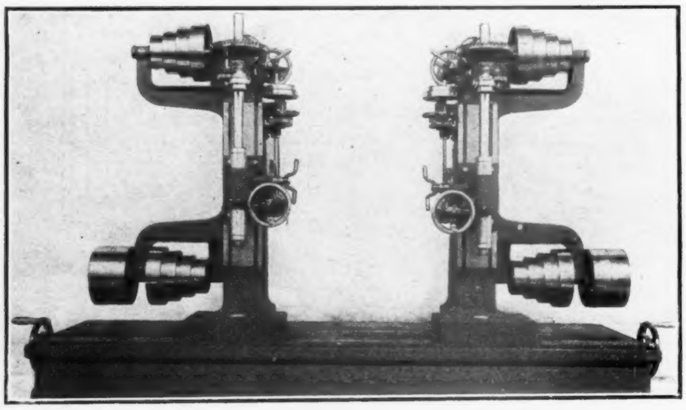
Mountain grade work naturally develops expert handling of the air brake. The writer recently rode in the rear car of an eleven-car passenger train from Yampai, Arizona, to Needles, California, and did not once feel the brakes go on or off. The distance is 126 miles and the difference in elevation is 107 ft. less than one mile. The engineers on the Santa Fe who do this regularly, every day, deserve most prominent mention of their work.

In that section air brake failures are unheard of. No chances are taken. The Santa Fe will accept a freight car without brakes, but these cars are piped before being switched into trains. The yards near mountain grades are all equipped with air piping and near at hand is an engineer's valve in the cabin of the air brake inspectors. A through freight arriving in one of these yards is stretched from the rear end by the hand brakes and is stopped by the engineer with a 20-lb. reduction. This sets the brakes hard and the road engine leaves the train ready for the inspectors. Four men inspect the train. Two start at each end at opposite sides and work toward the center. They make the usual inspection of trucks and wheels and also of the brakes, noting carefully the piston travel. A fifth man follows them and makes adjustments and replacements in accordance with the chalk marks of the inspectors. When through, the train is tested and defective triples and other parts are replaced. All this is done in about twenty minutes. The triples are cleaned and tested by the repairman, between trains, and those requiring repairs are sent to the shops. These inspectors are intelligent men and are encouraged by the officers of the company by promotion.

A NEW DOUBLE BORING MACHINE.

For Boring Locomotive Connecting Rods.

The accompanying half tone illustrates a new design of double boring machine that Prentice Bros. Co., Worcester, Mass., have recently developed for the simultaneous boring of both ends of a locomotive connecting rod at one setting of the rod upon the table. This is a special tool and has a wide field of usefulness, both with the locomotive builders and at large locomotive repair shops. Its important details are worthy of note.



THE NEW PRENTICE DOUBLE BORING MACHINE FOR SIMULTANEOUSLY BORING BOTH ENDS OF LOCOMOTIVE CONNECTING RODS.

This tool consists of two complete and independently driven drilling machines, mounted upon a heavy base and having lateral adjustment thereon, as shown. The head of each machine is adjustable upon its upright and each spindle is amply counterweighted to provide for heavy boring bars. Each base is bored for a bushing to support and guide the boring bar. Each machine has an oil pump and the necessary piping for delivering oil in steady flow through the spindle and the subbase has a deep trough around the edge to catch the oil.

Each head is provided with the usual hand and power feeds, and also the well-known Prentice improved quick return and stop motion, which permits the spindle to be quick returned or approached with power feeding, and the point of the boring tool to be brought to the work and power feed thrown in by the same lever, while the machine is in operation. The drive has eight changes of speed by means of the 4-step cones and back gears, and four changes of feed are provided. The remaining important features and dimensions are presented in the following table:

SPECIFICATIONS.

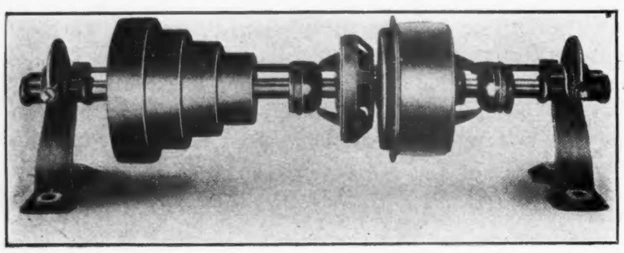
Capacity	12-in. holes in each end of a connecting rod
Spacing of holes	From 32 ins. to 126 ins. between centers
Maximum distance, spindles to bases	33 ins.
Minimum distance, spindles to bases	5 ins.
Traverse of spindles	13 ins.
Diameter of spindle in sleeve	2¾ ins.
Nose of spindle	3⅛ ins.
Total ratio of driving gearing	1 to 20; of back gears, 1 to 5
Height of tool, over all	8 ft. 9 ins.
Floor space	13 ft. x 4 ft.
Weight	17,500 lbs.

THE SMITH ONE-BELT REVERSING COUNTERSHAFT.

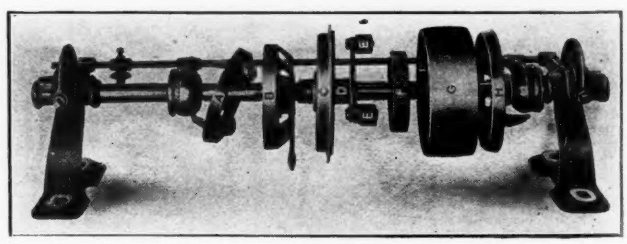
The Smith Countershaft Company.

A novelty in a countershaft for driving machine tools and other machinery from main line shafts is being introduced by the Smith Countershaft Company, Melrose, Mass. This new type of countershaft is illustrated in the two accompanying illustrations, one of which shows the speed cone removed and parts opened out to view.

The important feature of this new device is that it obviates the use of two belts, one straight and the other crossed, for the reversing feature, as is commonly resorted to in the usual types of countershaft. A single driving pulley is used, pulley G in the detail view, and the gears are used only for reversing. Its operation, however, does not differ from that of the ordinary counter shaft, as by moving the shipper handle in one direction, the forward motion is obtained and, in the other direction, the reverse motion.



THE NEW SMITH SINGLE BELT REVERSING COUNTERSHAFT.



UNASSEMBLED VIEW OF PARTS OF THE SMITH SINGLE BELT REVERSING COUNTERSHAFT.

The principle of operation of the mechanism may be understood by reference to the detail view: The driving pulley G turns loosely upon the shaft, unless clutched by friction plate, H, which is drawn against its right hand side for forward motion. The reverse motion is obtained through the special gear arrangement within pulley G.

This gear mechanism consists of the three pinions, E-E, which are mounted upon a strong spider, D, and mesh with both gear, F, and the internal gear, I, cut inside the rim of pulley, G. Gear, F, is keyed rigidly to the shaft and when spider, D, and pulley, G, are brought into position they enclose it and mesh exactly. The friction ring B is held stationary at all times, the hub of the spider running freely in it. The friction cone A is threaded to the hub of the spider D and is capable of being clutched to the ring B, thus holding the spider stationary and giving the reverse drive. The friction ring, B is held stationary and prevented from revolving.

For reverse motion, the process is as follows: The shipper handle is thrown so as to engage friction ring, A, with frame, B, which stops ring, A, and thus spider, D, from revolving; then with pulley, G, in motion as usual, and pinions, E-E, held stationary, gear, F, and consequently the shaft are given a reverse motion at a speed similar to pulley G; the countershaft will run faster backwards than forwards, the internal gear being the driver and the spur the driven member.

This principle of planetary gears which is made use of is well known and has been well tried for such work as this; this application is quick acting and efficient, and the use of the friction clutches makes the starting and stopping action smooth. The gears, E E, are fiber pinions, cut to mesh accurately with both gear, F, and the internal gear, I, and thus in reverse motion the mechanism causes a minimum of noise.

The most important feature of this countershaft is to be found in the reduction by 50 per cent of belts and pulleys required; for the belt maintenance of a large railroad shop this would be an item of considerable importance. The additional room that is made available upon the main line shaft is also an item of considerable importance, as it permits more machines to be placed in a shop per unit of main line shaft length. Also the reduction of extra belts and pulleys actually makes this new countershaft cheaper and easier to install than the older style. The makers, the Smith Countershaft Company, will be pleased to give further information to anyone interested upon request.

PASSENGER LOCOMOTIVE FOR THE VANDALIA.

4—4—2 (ATLANTIC) TYPE.

Four passenger locomotives for this road have just been delivered from the Schenectady works of the American Locomotive Company. These are heavy engines, weighing 179,444 lbs., with 109,500 lbs. on driving wheels. This is the most remarkable feature of the design, as a weight of 27,375 lbs. per wheel is the greatest driving wheel load in our record of locomotives. This even exceeds the practice of the Pennsylvania Railroad in the Class E 2 and E 2a engines, which have 109,033 and 109,000 lbs. on drivers, respectively. The Vandalia engines have 9½ by 13 ins. driving journals, and the details show unusual care, especially in the valve motion, where the links and motion pins are made to give a straight pull and thrust to the connections. These engines have boilers 70⅝ ins. in diameter, which is one of the largest ever put into a passenger engine. But the heating surface is 3,100 sq. ft., which is in line with the tendency toward sacrificing a few tubes for the purpose of securing good circulation space between them. These boilers have 351 2-in. tubes with 13-16 in. vertical spaces between them. Water spaces of 4 ins. are provided all around at the mud ring. In the accompanying tables the usual dimensions and ratios are presented:

RATIOS.

Heating surface to cylinder volume	= 298.00
Tractive weight to heating surface	= 35.36
Tractive weight to tractive effort	= 4.43
Tractive effort to heating surface	= 7.97
Heating surface to grate area	= 61.8
Heating surface to tractive effort	= 12.8%
Total weight to heating surface	= 57.7

GENERAL DIMENSIONS.

Gauge	4 ft. 8½ ins.
Fuel	Bituminous coal
Weight in working order	179,000 lbs.
Weight on drivers	109,500 lbs.
Weight engine and tender in working order	321,820 lbs.
Wheel base, driving	7 ft.
Wheel base, rigid	16 ft. 6 ins.
Wheel base, total	27 ft. 3 ins.
Wheel base, total, engine and tender	57 ft. 10¾ ins.

CYLINDERS.

Diameter of cylinders	21 ins.
Stroke of piston	26 ins.
Horizontal thickness of piston	5¾ ins.
Diameter of piston rod	3¾ ins.
Kind of piston packing	Cast-iron rings
Kind of piston-rod packing	U. S. metallic
Size of steam ports	18 x 1⅝ ins.
Size of exhaust ports	18 x 3 ins.
Size of bridges	1⅜ ins.

VALVES.

Kind of slide valves	Allen American
Greatest travel of slide valves	6 ins.
Outside lap of slide valves	1 in.
Inside lap of slide valves	Line and line inside
Lead of valves in full gear:	1-16 in. negative lead, both front and back motion
Kind of valve-stem packing	U. S. metallic

WHEELS, ETC.

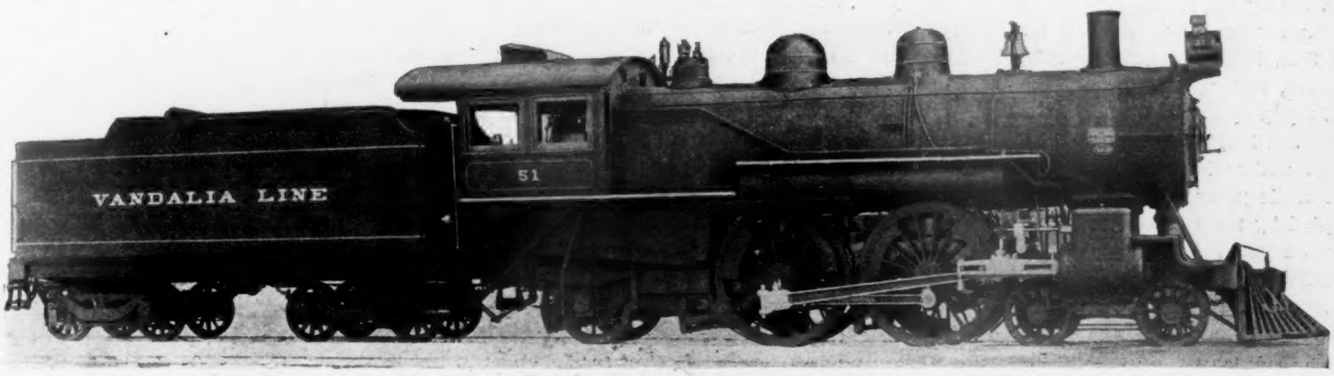
Number of driving wheels	4
Diameter of driving wheels outside of tire	79 ins.
Material of driving-wheel centers	Cast steel
Thickness of tire	3½ ins.
Driving-box material	Cast steel
Diameter and length of driving journals	9½ ins. diameter x 13 ins.
Diameter and length of main crankpin journals:	(Main side, 7 ins. x 4¼ ins.) 6½ ins. diameter x 7 ins.
Diameter and length of side-rod crankpin journals:	Front, 5 ins. diameter x 3¾ ins.
Engine-truck journals	6 ins. diameter x 10 ins.
Diameter of engine-truck wheels	36 ins.

BOILER.

Style	Straight top, radial stays
Inside diameter of first ring	70⅝ ins.
Working pressure	200 lbs.
Thickness of plates in barrel and outside of firebox	¾ in., ½ in., ⅝ in.
Firebox, length	96⅛ ins.
Firebox, width	75¼ ins.
Firebox, depth	Front, 80¼ ins.; back, 69 ins.
Firebox plates, thickness:	Sides, ⅜ in.; back, ⅜ ins.; crown, ⅜ ins.; tube sheet, ½ in.
Firebox, water space	Front, 4 and 6 ins.; sides, 4 ins.; back, 4 ins.
Firebox, crown staying	Radial
Firebox, staybolts	Ulster special iron, 1 in. diameter
Tubes, number	351
Tubes, diameter	2 ins.
Tubes, length over tube sheets	16 ft.
Heating surface, tubes	2,923.3 sq. ft.
Heating surface, firebox	177.1 sq. ft.
Heating surface, total	3,100.4 sq. ft.
Grate surface	50.2 sq. ft.
Exhaust nozzles, diameter	5¼, 5½, 5¾ ins.
Smoke stack, inside diameter	16 and 17 ins.
Smoke stack, top above rail	14 ft. 11 9-16 ins.

TENDER.

Style	Water bottom
Weight, empty	56 320 lbs.
Wheels, diameter	36 ins.
Journals, diameter and length	5½ ins diameter x 10 ins.
Wheel base	21 ft. ½ in.
Water capacity	7,500 U. S. gals.
Coal capacity	12 tons



PASSENGER LOCOMOTIVE 4-4-2 TYPE VANDALIA LINE.

W. C. Arp, Superintendent Motive Power. AMERICAN LOCOMOTIVE COMPANY, *Schenectady Works, Builders.*

A VISIT TO THE WORKS OF J. G. BRILL COMPANY.

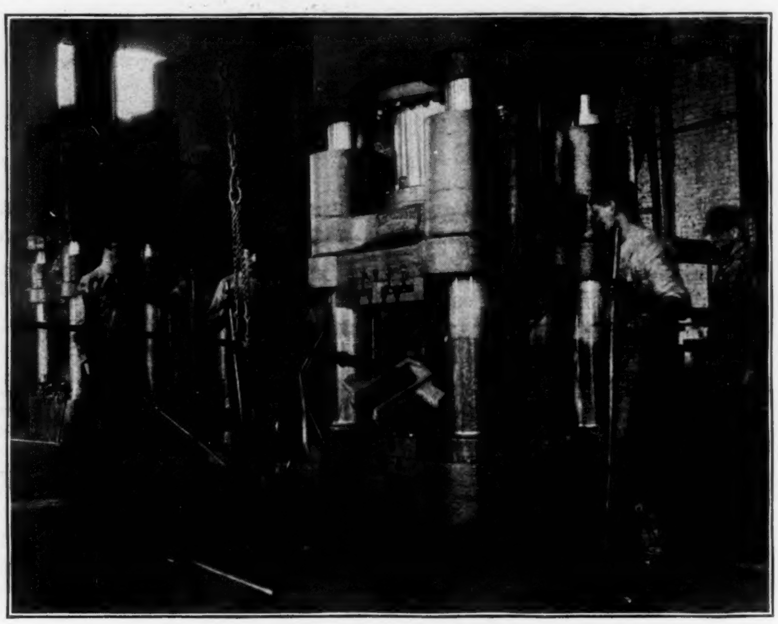
When the business of the J. G. Brill Company, car and truck builders, had outgrown the large plant at 31st and Chestnut streets, eighteen and a half acres of land at 62nd street and Woodland avenue were purchased and much larger shops and buildings erected. That was about fifteen years ago. Since that time, and from time to time, these buildings have been increased in size, several of them have been replaced by larger structures, many new buildings added, and to-day the works are the most complete and best equipped for the building of electric cars and trucks of any in the world.

Passing in at the gate, the visitor sees at the right a large two-story finishing shop with a frontage of 200 ft. and nearly as deep. It contains nearly three-quarters of a mile of railroad tracks, and has a specially designed combination transfer table and elevator electrically operated in a long pit at the front of the building, by means of which the largest cars are quickly placed on any track on either floor. After crossing many tracks filled with cars and trucks ready to be shipped, one approaches the office building at the end of a line of buildings 680 ft. long. The rear doors of the offices open almost at the center of the works, and are very conveniently located for the frequent trips of the officials through the shops. Let us start from this point and passing the stock room for castings and the pattern department, enter the blacksmith shop. At first one sees small furnaces with many men wielding hammers, and is confused by the deafening roar of a multitude of machines. A couple of hundred feet farther, we come upon many one, two, and three thousand-pound steam hammers and heavy "bulldozers." Here some of the side frames of the trucks are forged, and large pieces of ironwork for cars, such as bolsters and trusses are made. Leaving this building, we pick our way among great piles of iron and steel billets to another forge shop, 75 by 160 ft., equipped with heavy steam

hammers and 2,000-ton hydraulic presses, where the most intricate large forgings in the world are made—a process of manufacturing side frames for trucks peculiar to this firm. The operation of these enormous presses, and the rapid and carefully trained movements of the gangs of men who handle the bulky pieces of white-hot metal with wonderfully devised derricks, is perhaps the most fascinating of all the wonderful things that are to be seen in this busy hive. In the shop adjoining, a building of equal size to that from which we have just come, are a great variety of the latest types of spring-making machines, which mix their clatter with the roar of oil-burning furnaces.

Next we shall go to the machine shop, a three-story building, 100 by 125 ft., erected during the past year, and enclosing at the rear a chimney stack 175 ft. high, with opening at the top 8 ft. in diameter. The shop is filled with multiple drills, planers, lathes, milling machines, boring mills, turret lathes, and many specially devised automatic machines. The material from the forge shops is bored and finished here; castings are also bored and finished, sheet metal stamped, and dies for the hydraulic presses cut. A part of the first floor is occupied by the engine and pump rooms. A large Corliss engine furnishes 300 h.p. to machinery in the wood mill, and drives two-belted generators, furnishing light and power; a direct-connected 200 KW. unit is driven by a Harrisburg and held in reserve for use, when the belted units are stopped; a Ball engine drives a high-voltage generator which furnishes current for the trolley system of the plant; an arc-light engine and generator furnishes 5,000 volts for 100 lights. The company is changing its entire system from belt to motor-driven machinery, using 25-h.p. motors as standard, and at the present time have four 25-h.p. motors in the machine shop, three in the wood mill, one 50-h.p. motor in the spring shop, four ranging from 15 to 40 h.p. in the blacksmith shop, and others in various departments. A new boiler house at the rear of the machine shop contains a main battery of four return-tubular boilers of 600 h.p. capacity each, and two boilers of 400 h.p. each. Connected with the machine shop by a bridge and a transfer table is the truck-assembling shop, where the heavy parts are handled by pneumatic hoists. This is a three-story building, 160 by 60 ft., and includes an axle and wheel-grinding department. An engine room adjoins which furnishes air for the pneumatic hoists and tools. The wood mill, a three-story building, 80 by 180 ft., is connected with the lumber sheds and drying rooms by bridges and a number of trolley lines. Here, as elsewhere, the most improved types of machines are used. A 75-h.p. high-speed Harrisburg engine operates blowers which draw the sawdust and shavings from the machines through a system of piping to two large separators over the boiler room. Crossing a bridge, we find ourselves on the second floor of a building 100 by 140 ft., the first floor of which is used for boxing cars and large pieces of material.

Before going to the erecting shops, we will look in at the door of the bending house, a two-story building, 120 ft. long. The wood is steamed in tanks of various sizes, after which the pieces are clamped to forms and placed in drying rooms. Returning between the wood mill and packing shop, taking care not to get in the way of a traveling crane which extends the entire length of these buildings, we cross the tracks of a transfer table which runs for 340 ft. between the machine shop, wood mill, and packing shops, and a long section of erecting shops. In the first erecting shop we enter, we see car sills being put together with cross members and tie-rods, and covered with flooring. This comprises the bottom framing, which as soon as completed, is mounted on shop trucks and commences its journey which ends when the completed car rests on its own trucks in the finishing shop. In the next shops the side posts are set up, the ends built in, and the roofs put in place. Those who know nothing of car building can have but a faint conception of the framed skeleton that is between the panels and sheathing and the finished woodwork. As lightness is essential in an electric car body, and as it is not uncommon for the body to carry a load twice its own weight, every piece of wood and material is placed in such a manner as to give the greatest possible strength, trusses and tie-rods playing an important part. Leaving this section of the erecting shops, which cover 200 by 320 ft., we cross another transfer table electrically operated over a pit 360 ft. in length, with another section of erecting shops extending the full length of the table, and see cars in every stage of building, from the bare framework to the nearly completed cars. Platforms, vestibules, head-linings, windows, and interior woodwork are installed, and the first coats of paint applied. Following a track which leads from the end of the transfer table around the rear of these buildings, we find ourselves back at the finishing shop whence we started. In this shop the painting, lettering, decorating, and varnishing is done; the seats, heaters, and the rest of the equipment are put in place, and the cars mounted on their trucks. It is interesting to note the large variety of types of



A LARGE HYDRAULIC FORGING PRESS.
AT THE WORKS OF THE J. G. BRILL COMPANY.

cars all of which have their special fitness for the conditions found in those cities whose names are seen on the letter boards: Double-deckers for England, Europe and Mexico; combination open and closed cars for the mild climates of the Pacific coast, South America, South Africa, and elsewhere; convertible cars, whose windows and panels slide up into pockets in the side roofs; semi-convertible cars with large windows which are also stored in roof pockets when not in use; the "Narragansett" type of long open car with its convenient pair of steps at each side, and many others, including sumptuously furnished private cars, powerful electric locomotives, sprinkling cars and sweepers. One is impressed with a large number of cars approximating in size and appearance the finest coaches in steam railway service, and showing the rapid development of interurban electric railroading.

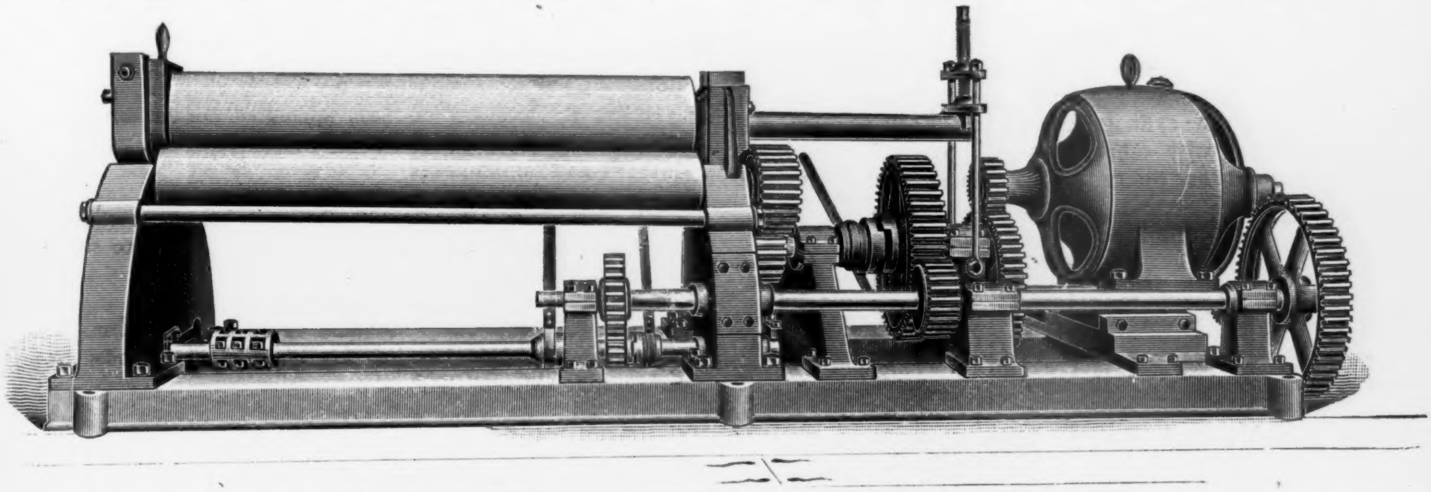
Before leaving, the visitor should know about a few departments and other things he has missed—the extensive varnishing rooms, the glazing, upholstering, drafting, and electrical equipment departments, the shipping platforms and wheel sheds, the equipment for fire protection, including an elevated 50,000-gallon reserve tank, and two "Underwriter's" fire pumps, each with a capacity of 1,000 gallons per minute. Tracks from the Pennsylvania and the Baltimore & Ohio lines enter the yards and pass through the principal buildings, and a complete trolley system connects all of the buildings—about six and a half miles of tracks in all.

A HEAVY POWER BENDING ROLL.

CINCINNATI PUNCH & SHEAR COMPANY.

The illustration presented herewith shows a new motor-driven power, pyramid bending roll of improved design, recently built for the government by the Cincinnati Punch & Shear Company, Cincinnati, O. As shown, the machine consists of three forged steel rollers placed in pyramid form; the upper one, which is the heaviest, has a solid extension arm for tilting it, when it is desired to take out the formed cylinder, and tne opposite end has a hinged housing which may readily be tipped back clear of the upper roll journal.

The machine is triple geared, and the gears connected with motor are cut, while those on ends of the rolls are of steel and are in all cases ample for the maximum capacity of the machine. The upper roll is raised and lowered by power, and this device is usually heavy, so that, with the lower rolls at rest, the upper may be used for corner bending and other like work. In connection with this there is a clutch, with which, when disengaged, cone work may be formed. The upper roll housing is reinforced on both sides and at both ends by heavy forged steel bars, which take much of the strain off of the screws.



A NEW PYRAMID BENDING ROLL (MOTOR-DRIVEN) OF PARTICULARLY HEAVY DESIGN.
BUILT BY THE CINCINNATI PUNCH & SHEAR COMPANY.

The motor used is a heavy General Electric motor of the reversible type, which gives the operator instant control of the machine. The rolls and the driving mechanism are all mounted on a heavy cast iron bed frame. The width in this particular case between the housings is 6 ft. 2 ins., but this type of machine is built by the Cincinnati Punch & Shear Company in several sizes up to 16 ft., the wider ones having a four-point contact center bearing beneath the lower rollers.

OVERLOADING LOCOMOTIVES.

Overloading of locomotives is a practice which no progressive manager will permit, after he has studied its effects. The tonnage rating craze has brought a remarkable development to the locomotive, but it is now time for sensible and intelligent loading of locomotives—in short, for common sense in this matter. It has been satisfactorily demonstrated that about 15 miles per hour is an economical speed for freight service and this speed should be the basis for tonnage rating, where the grade conditions permit. Mr. G. J. Bury, general superintendent, Canadian Pacific, says: "If freight trains average 15 miles an hour, train and enginemen can make 5,000 miles a month, while if the average be reduced to eight miles an hour the men cannot stand more than 3,000 miles a month. Sixty crews at 15 miles an hour will make 300,000 train miles per month, while at an average of eight miles an hour it will take 40 more crews or 200 extra men to handle that business.

"Looking at the matter from a financial standpoint, a consolidation engine hauls a train weighing 1,100 tons (tare and contents), over 118 miles in a district where there are several grades of 1 per cent.; taking into consideration the time for meeting trains, and letting faster trains pass, slowing up over grades, etc., it averages eight miles an hour, the cost being as below:

Wages engineer and fireman	$6.90
Wages engineer and fireman overtime	1.75
Wages conductor and brakemen	7.73
Wages conductor and brakemen overtime	2.88
Oil and waste for locomotive	$ .30
Fuel (7 tons at $3.20)	22.40
	$41.96

Or 32.3 cents per thousand ton miles.

"The same train, if loaded with 1,000 tons (tare and contents) averages 15 miles an hour over the same district, and the cost is as follows:

Wages engineer and fireman	$ 6.90
Wages conductor and brakemen	7.73
Oil and waste for locomotives	.30
Fuel (6 tons at $3.20)	19.20
	$34.13

Or 28.8 cents per thousand ton miles.

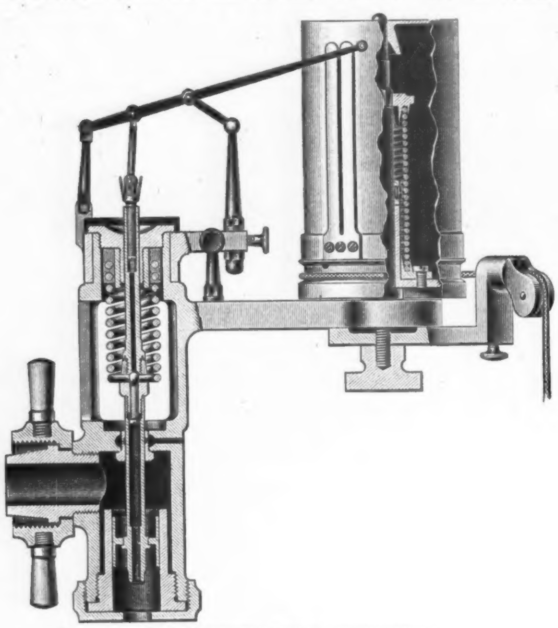
"The economical engine load is variable and is governed, not only by the number and length of grades, but by the density of traffic. On a road where traffic is very light at certain periods and dense at other periods, it might be good transportation to load engines heavily during light traffic, but it would be suicidal to load engines heavily when traffic was dense, even one train staggering and doubling over a district will demoralize the trains following and those met, resulting in overtime, extra consumption of fuel, and the risk of train accident which increases when train and enginemen are long hours on duty. In loading engines it has been the practice on some roads to so load them that they would haul a train at seven miles an hour over the steepest grade. If the steepest grade were of short length, no great delays might result, but if the steepest grade for instance, was to be eight miles in length, an engine, with a run for it, would take one hour to make the eight miles and the longest time it takes to make the distance between two stations is what limits the traffic. With trains loaded in this way, the traffic would be greatly restricted.

"In a general way locomotives should be so loaded when traffic is dense that they may make an average speed over a district of 15 miles an hour, providing there are no unusual delays, and while theoretical tests are all very well for a basis on which to work, the only way to arrive at the engine load is by actual tests in practice. After ascertaining what an engine will do in actual practice the load should be shaded slightly from this. No fixed rule can be given for the loading of engines, but the conditions of each district at each period must be closely studied and the load be made such that the train can make reasonably good time. It may be taken as a general principle (providing engines are in good condition) that, where trains are a long time on the road, and the dispatching is not at fault, that the engines are too heavily loaded. A live superintendent will hustle over his district on freight trains, be on the ground where the trouble lies, and fix the load to meet the conditions without delay."

THE STAR IMPROVED STEAM ENGINE INDICATOR.

This indicator has two specially strong features. It has an outside spring and a very small piston area which admits of using a light spring with a free motion.

It has been developed by the Star Brass Manufacturing Company, Boston, Mass. The Bureau of Steam Engineering, U. S. Navy Department has taken the position that hereafter all indicators furnished for the use of the government must have outside springs. This instrument was developed to meet this requirement and it has been done without increasing the veight of the moving parts. The drum pencil motion is the same as that previously used by this company, but the area of the piston has been reduced from one-half to one-quarter of a square inch which permits of using a small size of wire in the spring. Instead of being compressed, this spring is elongated in action, which tends toward bringing the motion in a direct line, avoiding cramping and excessive friction. The pencil operates in a way directly opposite to that of inside spring indicators and the atmospheric line is at the top of the drum. Instead of being at the bottom, the cylinder connection is at the side of the instrument and an angle cock is used to mount it, which brings the steam pressure on top of the piston. It is easy to remove the cylinder for cleaning or examination, without interfering with other parts and from the engraving it will be noticed that the end of the cylinder has no connection



IMPROVED STAR INDICATOR.

with the outer walls of the indicator. This permits of jacketing the cylinder with live steam and avoiding distortion of the cylinder by the heat. The drawing shows how the spring is removed from the hot steam and is not liable to change of tension or to deterioration.

Automatic stokers for locomotives were highly spoken of by Mr. J. F. Walsh, superintendent motive power of the Chesapeake & Ohio Railroad, and Mr. S. M. Vauclain, of the Baldwin Locomotive Works, at the March meeting of the New York Railroad Club. Both of these gentlemen considered the experience of the past few years sufficient to indicate a promising future for stokers, and they thought that the device would make very rapid progress in the near future.

"What is the true principle of organization in a democratic community? *Getting others to do what you want done while they are doing what they themselves wish to do."—Mr. Frenyear, before the Electric Club.*

Fairbanks, Morse & Company, of Chicago, have secured the services of Mr. M. Greenwood, formerly Pittsburg manager for the International Steam Pump Company, to take charge of their steam pump business in the Pittsburg territory.

PERSONALS.

Mr. William Rourk has been appointed car foreman of the Michigan Central at Chicago.

Mr. J. Dewey has been appointed acting master mechanic of the Erie Railroad at Galion, Ohio.

Mr. W. H. Wilson has been transferred as master mechanic of the Erie Railroad from Dunmore to Susquehanna, Pa.

Mr. W. S. Ganby has been appointed master mechanic of the Atchison, Topeka & Santa Fe Railway at Arkansas City, Kan.

Mr. T. J. Cole has been appointed acting master mechanic of the Erie Railroad at Meadville, Pa.

Mr. F. O. Bunnell has been appointed engineer of tests of the Chicago, Rock Island & Pacific Railway with office in Chicago.

Mr. R. F. McKenna has been appointed master car builder of the Delaware, Lackawanna & Western Railroad, with headquarters at Scranton, Pa.

Mr. T. Rumney has been transferred as master mechanic of the Erie Railroad, from Meadville to Jersey City, to succeed Mr. W. S. Haines.

Mr. E. R. Webb master mechanic of the Michigan Central at Michigan City, Ind., has had his jurisdiction extended over the Chicago district.

Mr. T. H. Ogden has been appointed master mechanic of the Mexican Central Railroad at Monterey, Mex., to succeed Mr. W. J. Wilcox who has been transferred to Chihuahua, Mex.

Mr. J. G. Riley the veteran master mechanic of the Michigan Central died at his home in Chicago, February 21. He began service with the Michigan Central in 1836 at Ann Arbor.

Mr. C. Graham, master mechanic of the Philadelphia & Reading at Philadelphia, has been transferred to the same position at Reading in charge of the Reading and Lebanon branches.

Mr. S. W. Taylor has been appointed master mechanic of the Chicago, Rock Island & Pacific at Cedar Rapids, Ia, to succeed Mr. J. H. Stubbs. Mr. Taylor has been superintendent of shops at that point.

Mr. J. H. Stubbs has been transferred as master mechanic of the Chicago, Rock Island & Pacific from Cedar Rapids, Ia., to Fiarbury, Neb., to succeed Mr. D. A. Hathaway who has resigned.

Mr A. H. Gairns, master mechanic of the Chicago, Rock Island & Pacific at Esterville, Ia., has been transferred to Trenton, Mo., in the same capacity, to succeed Mr. M. S. Monroe.

Mr. W. S. Haines, division master mechanic of the Erie Railroad at Jersey City has been appointed master mechanic of the Jefferson and Wyoming divisions and the New York, Susquehanna & Western Railroad with headquarters at Dunmore, Pa.

Mr. George W. Smith, assistant superintendent of machinery, and master mechanic of the Burnside shops of the Illinois Central, has been appointed superintendent of motive power of the Chicago & Eastern Illinois, with headquarters at Danville, Ill., to succeed Mr. Thomas A. Lawes, resigned.

Mr. George K. Hatz has been appointed master mechanic of the Chicago & Alton, with headquarters at Bloomington, Ill. Mr. Hatz has heretofore been general foreman of the Illinois Central at Burnside, Ill.

Mr. Henry Hardie has been appointed master mechanic of the Cumberland Valley division of the Knoxville branch of the Louisville & Nashville with headquarters at Corbin, Ky. He has been promoted from the position of general foreman of the shops at that point.

Mr. R. F. Kilpatrick has been appointed superintendent of motive power of the Delaware, Lackawanna & Western Railroad to succeed Mr. T. S. Lloyd. Mr. Kilpatrick has for several years held the position of master mechanic at Scranton.

Mr. B. P. Flory has been appointed mechanical engineer of the Central Railroad of New Jersey to succeed Mr. G. W. Wildin. Mr. Flory is a native of Pennsylvania. He was born in Susquehanna in 1873 and was graduated from Cornell University in 1895. He has had experience in mining engineering in Montana and began railroad service with the Lehigh Valley in 1899 as inspector and was afterward draftsman, chief draftsman, and mechanical engineer of that road. In connection with the construction of the new shop at Sayre Mr. Flory was transferred to the office of the chief engineer in New York and leaves this position to accept the appointment on the Central Railroad of New Jersey.

Edward A. Phillips who was well and widely known as the editor of the *Railroad Car Journal* and afterward as general agent of the National Railway Publication Company, died in New York, February 26, after a brief illness. Mr. Phillips was born in England in 1863 and came to this country in 1888. After spending several years at sea and securing a master's certificate at an unusually early age, his first work in the United States was in connection with the publication department of Messrs. Thos. Cook & Son. In 1890 he took up railroad newspaper work and soon began the publication of the *Railroad Car Journal* as editor, which he continued up to the time of its absorption into another publication. He was an able writer and was thoroughly familiar with mechanical railroad subjects. He was devoted to his many friends and will be sadly missed.

Mr. T. S. Lloyd has been appointed general superintendent of motive power of the Chicago, Rock Island & Pacific. To accept this appointment he has resigned as superintendent of motive power of the Delaware, Lackawanna & Western where his work for the past four years has been a conspicuous success and has attracted general attention because of the remarkably fine condition to which the department has been brought out of the chaos which formerly existed on that road. Mr. Lloyd is a man of strong personality, positiveness in carefully formed opinions, executive ability and good business judgment. With these he combines a very wide experience and is admirably fitted to direct the important organization to which he has been called. He began as a machinist on the Toledo & Ohio Central and has served in the mechanical departments of Atlantic & Great Western, the Pittsburg, Fort Wayne & Chicago, and the Chesapeake & Ohio. He was for ten years master mechanic of the latter road at Richmond, Va.

Mr. F. N. Hibbits has resigned as assistant superintendent of motive power of the Union Pacific to accept the appointment as consulting engineer of the Southern Railway and its allied lines. These include the Queen & Crescent system, the Central of Georgia, the Mobile & Ohio, and the Georgia Southern & Florida, a total mileage of nearly 12,000 miles. He will report to a committee of the mechanical officers of these roads, including Mr. Samuel Higgins, mechanical superintendent of the Southern Railway. Mr. Hibbits is 37 years of age and a graduate of Rose Polytechnic Institute. In 1886 he entered the service of the Cleveland, Columbus, Cincinnati & Indianapolis as machinist and was soon placed in charge of mechanical engineering work on that road. In 1891 he went to the New York, Lake Erie & Western as engineer of tests and in 1892 was made mechanical engineer. In 1894 he was appointed master mechanic of the Rochester division. He has also had experience in the operating department as trainmaster and as division superintendent. For about three years he has been with the Union Pacific as mechanical engineer and assistant superintendent of motive power.

Mr. George W. Wildin, whose appointment as assistant mechanical superintendent of the Erie Railroad was announced last month, has held the position of mechanical engineer of the Central Railroad of New Jersey for the past three years, where his work was specially successful because of his wide road experience. Mr. Wildin is 34 years of age. He is a graduate of the Agricultural and Mechanical College, Manhattan, Kan., and began railroad service as a draftsman in the mechanical department of the Atchison, Topeka & Santa Fe Railway at Topeka. He served in this capacity and as a locomotive fireman for four years and then entered the service of the Mexican Central as locomotive engineer. After this he was connected with the department of the chief engineer of that road. He then went to the Chicago & Alton as locomotive engineer and next served as machinist, locomotive engineer and mechanical engineer of the Plant System. From the latter position he went to the Central Railroad of New Jersey in the same capacity. Mr. Wildin thus combines technical preparation with a great deal of practical road experience, which render him a very valuable addition to the staff of the Erie Railroad. He is a member of the American Society of Mechanical Engineers, of the Master Mechanics', the Master Car Builders' Associations and is first vice-president of the Traveling Engineers' Association. It is only through a record of hard and effective work that a man of his age is called to a position of this importance.

Locomotive frames was the subject of a characteristically thoughtful and able address by Mr. S. M. Vauclain before the New York Railroad Club March 18. After illustrating by lantern slides the progress in frame construction and frame splices, which accompanied the increasing size of locomotives, the speaker showed that the recent serious trouble from breakage was not due to lack of strength. He believed it to be a result of water in the cylinders which did not find sufficient relief through piston valves or valves of the balanced type which permitted too little motion with reference to the balance plate to allow water to escape. It is doubtful if the general subject of frames has ever been so well summed up before and the development of frame splice construction so clearly traced. The speaker's arguments with reference to the necessity for the escape of water were clear and impressive. Cast steel as a material for frame construction was strongly advocated, because the material was nearly twice as strong as wrought iron and was more likely to be homogeneous than welds in wrought iron were sure to be sound. Judging from this address the report of the committee on this subject before the Master Mechanics' Association next June is likely to be exceedingly valuable. In the discussion, Mr. Deems said that he had seriously considered making locomotive frames of slab form out of ship plate material.

AN OBJECT LESSON IN FIREBOX SIDE SHEETS.

At the last convention of the Master Steam Boilermakers Association there was a novel exhibit presented for the purpose of demonstrating the effect on side sheets, of a narrow water space at and above the foundation ring of a firebox. Mr. John H. Smythe, formerly foreman boilermaker of the Chicago & Alton, arranged to illustrate the effects of overheating of the side sheets, by laying off a board to represent the locations of staybolts, in the side sheet by punched holes, and, into the punched holes in the board, placing punching or burrs from the firebox sheet in the relative positions occupied while in the firebox, as in Fig. 1. These sections of the sheet show the fire side and the effect is evident in the minute cracks, which are greatest in the part of the sheet enduring the most intense heat. Referring to this exhibit Mr. Smythe said in part:

"We had trouble with staybolts breaking from the start; and the engine has been out about forty days since we put in the new half side sheets, and have had no trouble with staybolts leaking. It is hard to say what makes the side sheets crack, but I attribute it largely to bad water. The Sante Fe made a very good test by putting in some water gauge cocks along the side at the hottest points, running the pipe of the first through the outside sheet to within ⅛ of an inch of the inside sheet, the second, within ¼ of an inch, and the third within ½-in.

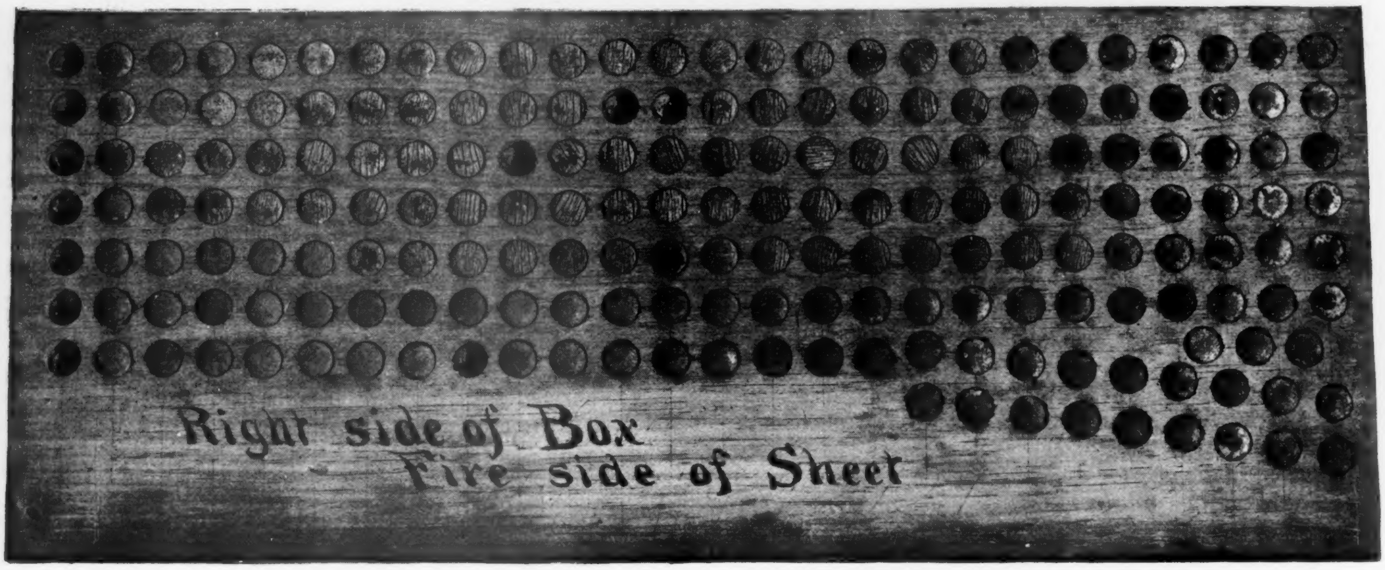


FIG. 1.—PUNCHINGS FROM FIREBOX SHEETS SHOWING CRACKS FROM OVERHEATING.

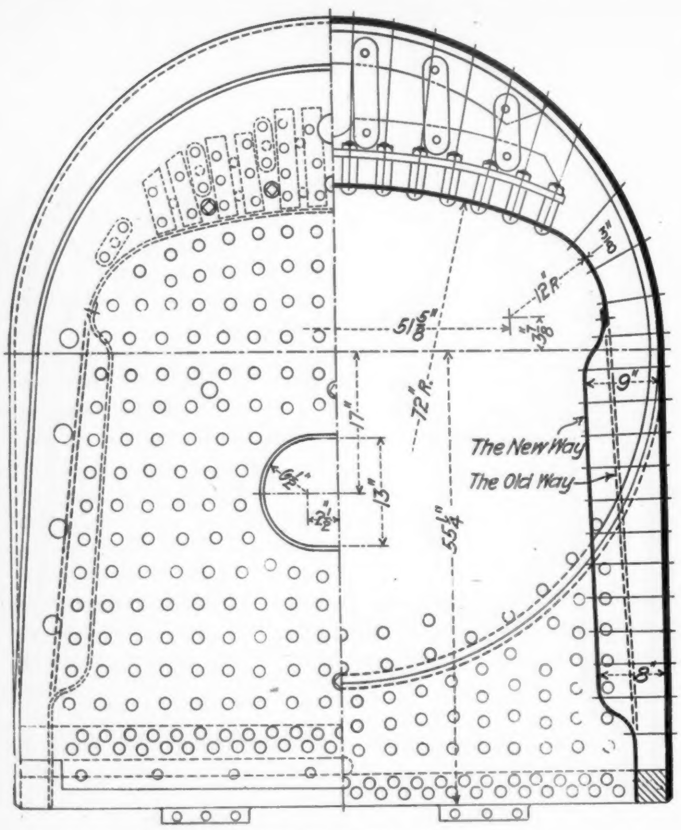


FIG. 2.—SMYTHE'S OFFSET SIDE SHEETS.

"I believe the result of this test was that the first one which was within ⅛-in. of the inside sheet, showed dry steam, the second wet steam, and the third water. This goes to show that the water boils away from the side sheets and I believe our water spaces are too narrow. In order to try to overcome this I have offset the half side sheet, as shown in the drawing, Fig. 2, making the water space 9 ins., also putting the flange of flue and door sheet in the water from top of side sheets down.

"I have at the present time five engines in the boiler shops for half side sheets and radial stays, all of the engines having been delivered to the company last August. You will notice I said that I had no trouble with engine 421 since putting in half side sheets, although she gave us trouble all the time before that, so I believe the offset side sheets will do the work. It will allow the side sheets to expand."

The advantages resulting from the wide water space around a firebox, are an increased volume of water through which to transmit the heat, and also a reduction of bending moment due to the longer staybolts; both of these factors are of the greatest importance in prolonging the life of a firebox, since with a wider space the circulation must be improved, thus doing away with the deadly steam film next the sheets, and with the larger staybolts, the stress due to expansion and contraction of side sheets, must be decreased. The use of side sheets curved at the top and bottom as indicated, is a novel method of construction, and one that ought to have a beneficial effect in taking care of the expansive forces. The shape makes possible a wide water space above the fire line, the widest we have any knowledge of, a construction for which we have contended as being one of the remedies for firebox troubles. In any event the results will be watched with much interest as they will be the outcome of a battle royal with bad water conditions. We beg to acknowledge courtesies extended by *Motive Power* for data contained in this article.

Mr. Samuel Higgins has resigned as mechanical superintendent of the Southern Railway, to become general manager of the New York, New Haven & Hartford Railroad, succeeding Mr. W. E. Chamberlain. Mr. Higgins was born in 1860 in San Francisco. He began railroad work with the New York, Lake Erie & Western, in 1881, as machinist apprentice. After serving as machinist, assistant foreman and general foreman at the Susquehanna shops, he was appointed engineer of mo-

tive power, in 1887. He served for two years as division master mechanic and in 1892, was appointed assistant superintendent of motive power. In 1894, he went to the Lehigh Valley Railroad as superintendent of motive power. In April, 1901, he was called to the Union Pacific as superintendent of motive power, and in June, 1902, he went to the Southern Railway as mechanical superintendent, the position which he now leaves. His present appointment is a recognition of his ability and wide experience and this selection of another successful motive power officer for a high operative position indicates the importance of motive power responsibilities and training for higher positions.

A great amount of attention is being given to the question of rapid change-gear appliances on lathes, both by lathe builders and by lathe users, and an ever increasing preference is being shown for such lathes over less modern types. It will therefore be of much interest to the machine tool trade in general, and to lathe users in particular, to learn that the question of patent rights for the manufacture of lathes equipped with possibly the most improved and most efficient of such appliances has just been effectually settled. The American Tool Works Company of Cincinnati have, through purchase, acquired manufacturing rights under the several patents which have been issued pertaining to such devices. This gives them the undisputed right to build absolutely without restriction and under thorough protection from infringement litigations, their improved new "American" engine lathe with quick changing mechanism for thread cutting and feeding. This lathe has previously been shown in these columns and its merits are already well known and its exceptional possibilities in the way of rapid production are recognized by progressive shop managers. The line of sizes in which this lathe is built ranges from 14 in. to 36 in., inclusive, and full information on any size will, we are confident, be cheerfully furnished by the makers.

The American Blower Company of Detroit, Michigan, are at present installing their "A B C" fan system of heating in the new shops of the Olds Gasoline Engine Works at Lansing, Michigan, which contract they secured because of the excellence of the layout submitted to the engineers of the building. The building is one story in height, being a steel frame structure. It consists of one division running east and west 130 by 438 feet; one division running north and south 62 by 346; one locker office and wash room building 36 by 141 feet, and one paint storage building 20 by 20 feet. The heating apparatus is arranged to provide for an addition 130 by 438 feet to the main portion of this building, and to maintain an average temperature of 65 degrees F. throughout the present structure, with the exception of the offices and paint shop, which are to be heated to 70 degrees. This apparatus consists of four units, each made up of an "A B C" sectional base heater, having a capacity of 3,250 lineal feet of one-inch pipe, to which is attached an "A B C" full housed steel plate fan. The fan located in the 62-foot wing is special, having a housing 100 inches high and a wheel 66 inches in diameter. The other three fans are regular 120-inch "A B C" fans, with wheels 70 inches in diameter. All of the fans are operated by independent motors. All of this heating apparatus is carried on girders which span the roof trusses in the wings, and is entirely above the bottom chords of same.

BOOKS AND PAMPHLETS.

Traveling Engineers' Association. Proceedings of the Eleventh Annual Convention. Edited by the secretary, W. O. Thompson, Oswego, N. Y. Bound in flexible leather; 240 pages.

The work of this association along the lines of improving the operation of locomotives is exceedingly important. Its discussions cover a wide range of subjects, and are participated in by men who actually do the things they talk about.

Association of Railway Superintendents of Bridges and Buildings. Proceedings of Thirteenth Annual Convention, October, 1903. Edited by the Secretary, S. F. Patterson, Boston & Maine Railroad, Concord, N. H.

This volume contains the reports, records and discussions of the convention held in Quebec, Canada, last October, and among the specially valuable reports are one on water purification for locomotive use, and one on methods and equipment for storing fuel oil for supplying locomotives. The latter report contains many drawings and photographs, and constitutes the most complete collection of information on this subject which is available.

The Indicator Hand Book. A practical manual for engineers. By C. N. Pickworth, editor of the *Mechanical World*. Part I. The Indicator: Its Construction and Application. Second edition. New York. D. Van Nostrand Co., 23 Murray street. Price, 3s. net.

This little book is an excellent guide to the application of the indicator, and of all the works on this subject we have seen none better in its field. It describes a number of the best instruments, presents the history of the indicator, discusses its errors, its attachment, various methods of making connections, describes reducing gear and errors therein, and gives good advice as to the care and use of these instruments. The ground covered by this book should be carefully studied by those who are called upon to use indicators in their work, whether in steam or gas-engine practice.

Proceedings of the Master Car and Locomotive Painter's Association, 34th Annual Convention, held in Chicago, September, 1903. Published for the association by the Railway Master Mechanic, Chicago, 1903.

This volume of 150 pages contains papers, reports and discussions of paints and painting from the standpoint of those who paint locomotives and cars. It is a valuable record each year, coming as it does from entirely disinterested people who are users of vast quantities of paints and varnishes for the most exacting service which these materials are called upon to perform. The value of the proceedings to those who are not members of the association would be greatly increased if the index was more complete and if the titles of the papers were set in large type in the form of headings. These annual volumes are exceedingly valuable in the literature on the use of paints, in fact their value is unique, because the opinions come from men whose responsibilities are entirely confined to this special subject.

Proceedings of the Eleventh Annual Meeting of the Society for the Promotion of Engineering Education. Held in Niagara Falls, N. Y., July, 1903, and joint session with the American Institute of Electrical Engineers. Edited by Calvin M. Woodward, C. Frank Allen and Clarence A. Waldo, committee New York Engineering News Publishing Company. 1903. Price per volume, $2.50; to members, $1.50; to libraries, $2.

This volume is the largest and in many ways the most interesting issued by this society. It contains a number of valuable papers. Those by the late Prof. R. H. Thurston; a report on "Technical Books for Public Libraries"; one on education for factory management; a paper by Arthur W. Ayer on engineering education from the standpoint of the practical engineer, and others, are exceedingly important contributions to the literature of modern education.

American Compound Locomotives. A practical explanation of the construction, operation and care of the compound locomotives in use on American railroads. By Fred H. Colvin. First edition, 1903. Derry-Collard Co., 256 Broadway, New York. Price $1.50.

This book is written especially for locomotive engineers, firemen and shop men who have to do with compound locomotives on American railroads. It is thoroughly practical and generally descriptive, being written with a view of rendering the descriptions perfectly clear. The engravings are excellent, ten of the different types of compounds being illustrated by "duotone" engravings, which we have never before seen in books of this kind. The author has taken special pains, by aid of sectional drawings, to indicate the operation of the valves and show the manner in which the steam gets into and out of the cylinders and passages. The book deals with a portion of the history of the compound, and also contains instructions for locating and remedying defects in operation. It fills a specific need, and it should result in assisting in the proper maintenance and efficient operation of compound locomotives.

The Crocker-Wheeler Company, Ampere, N. J., have recently issued a large number of interesting publications, including the following bulletins and pamphlets:

Bulletin No. 40, "Crane Motors, Form K."; Flyer No. 145, "Electric Drive for Machine Tools with Methods of Variable Speed Control"; Flyer No. 153, "Machine Tool Equipments, Band Saw Driven by a Direct Connected Motor"; Flyer No. 154, "Band Saw Setting and Filing Machine with Contained Motor Drive"; Flyer No. 155, "3-in. Bolt Cutter with Motor Drive"; Flyer No. 156, "Contained Motor Drive on a 30-in. Drill Press"; Flyer No. 157, "Motor Drive on a Four-Spindle Mud-Ring Drill"; Flyer No. 158, "Motor-Driven 24-in. Lathe"; Flyer No. 159, "Motor Driven Gap Lathe with 28- and 48-in. Swing"; Flyer No. 160, "Heavy Turret Lathe with Motor Drive"; Flyer No. 161, "Light Milling Machine with Motor Drive"; Flyer No. 162, "Heavy Milling Machine with motor Drive"; Flyer No. 163, "Motor Drive Applied to a Gear Shaper"; Flyer No. 164, "Horizontal Boring Machine with Motor Drive"; Flyer No. 165, "Motor Drive on a 51-in. Boring and Turning Mill"; Flyer No. 166, "No. 4 Single Punch, Equipped With Semi-Enclosed Motor"; Flyer No. 167, "Motor Drive on a Rotary Bevel Shear," and Flyer No. 168, "Motor-Driven Bending Rolls."

American Blower Company.—This company has issued a catalogue devoted to the application of their waste-heat drying system as applied to the drying of bricks. It is known as "Catalogue No. 15," and while the subject is of special interest to brickmakers, the details of the apparatus described will interest others who have occasion to use drying apparatus for kilns or other purposes. It is an exceedingly handsome catalogue and beautifully gotten up in every way.

The Brady Brass Company report an excellent condition of business and most gratifying results in the service of their "Cyprus Bronze Bearing Metals" in driving boxes, rods, tender and truck brasses and journal bearings for both passenger and freight equipment. This company has sold several million pounds of this metal in the past fifteen years, and in the interests of its customers it brings to bear an experience of thirty-two years in the manufacture of bearing metals. Mr. D. M. Brady is president of the company. The New York office is at 95 Liberty street.

Poor's Ready Reference Bond List.—This edition, of January, 1904, contains all the important facts required by investors, bond experts, bankers, and others, relative to the bonded indebtedness, interest charges, etc., of the leading railroad systems of the United States. It is a supplement to *Poor's Manual of Railroads*, and is the third annual compilation of this department. All the bonds listed are carefully indexed, and the pamphlet is invaluable to those interested in bonds. It is published by Poor's Railroad Manual Company, 68 William street, New York.

Edison Storage Battery for Car Lighting.—The Gold Car Heating and Lighting Company has made an arrangement with Mr. Thomas A. Edison and his company for the exclusive sale in the United States of the Edison storage battery for car-lighting purposes. The railway car-heating business of the Gold Company has grown to a great extent, and the introduction of the new battery renders it necessary to move to larger quarters. They have taken a large suite of offices in the Whitehall building, 17 Battery place, New York, and have moved the Chicago branch and the New York office to that building.

Hollow Staybolts.—The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, have received a letter from Supervising Inspector-General George Uhler, of the Department of Commerce and Labor, indicating that the committee on boilers and machinery has made a careful examination of papers, letters and reports of comparative tests of staybolts submitted to them. The report of the committee concludes as follows: "All the data contained therein is very instructive and interesting reading, and we are of the opinion that the Falls Hollow staybolt is safe and efficient for use in the construction of locomotive and marine boilers."

"Jeffrey Screens" is the title of a pamphlet by the Jeffrey Manufacturing Company, Columbus, Ohio, which should be examined by every one having occasion to use screens for any sort of material. This company finds it necessary to devote a department to this branch of their work, and by reason of a wide experience they are prepared to meet all sorts of requirements for screening machinery for ores, sand, rock, coal, or any kind of material for which screens are used. This pamphlet is known as "Catalogue No. 69." It is comprehensive, and is illustrated by half-tones and working drawings of screening machinery in service.

Graphite.—The March number of the periodical bearing this title, which is published by the Joseph Dixon Crucible Company, is illustrated and printed in a way which compels notice. This number presents an imposing array of handsome engineering structures and buildings on prominent railroads and in large cities, indicating the appreciation of the Dixon graphite paints by use upon them. This number is a remarkably fine piece of work, showing that the architects of some of the finest buildings of the present day are protecting their steel and ornamental iron with these paints. The pictures of the new Hotel Astor, Keith's new Chestnut-street theater in Philadelphia, the new works of the Henry R. Worthington Company and others in this number constitute a convincing argument.

Woodworking Machinery.—The Jeffrey Manufacturing Company, Columbus, Ohio, have issued a new catalogue, "No. 57A," devoted to illustrated descriptions of machinery for saw mill, lumber and woodworking industries. The engravings are made from photographs of their machinery in actual use for elevating and conveying materials and finished product in the industries mentioned. This company finds it necessary to publish eighteen different catalogues in order to cover the wide range of its product. Any of these may be had on application. The pamphlet just received covers conveying machinery, pulleys, chains, link-belts, sheaves, shafting, hangers, ropes, sprockets, and many other details used in woodworking plants.

NOTES.

The Bettendorf Axle Company has found it necessary to establish an office in New York. Mr. G. N. Caleb is in charge and represents this company in the east with headquarters at 42 Broadway, New York.

Mr. Henry R. Dalton, Jr., has been elected president of the Baush Machine Tool Company, to succeed Mr. W. H. Baush who has resigned. Mr. C. J. Wetsell has been elected treasurer to fill the vacancy caused by the resignation of Mr. David Hunt, Jr. All communications should be addressed to the Baush Machine Tool Company, Springfield, Mass.

The Falls Hollow Staybolt Company of Cuyahoga Falls, Ohio, report the receipt of large orders of their hollow staybolt iron from Japan. These came through their agents, Messrs. Frazar & Company and the China & Japan Trading Company. This trade in Japan is increasing both with the railroads, marine boiler manufacturers and the government. This recognition of this material by so shrewd a nation as Japan is very pleasing to these staybolt people.

The American Nut and Bolt Fastener Company, 306 Frick Building, Pittsburgh, Pa., has elected the following officers: Mr. Milton Bartley, president and general manager; Mr. Frederick Bowery, vice-president; Mr. Barton Grubbs, secretary and treasurer; Mr. John C. Bowery, assistant secretary and treasurer. This company will have an exhibit at the St. Louis World's Fair. They now manufacture over 140 different sizes and designs of fasteners and in the year 1903 they equipped 18,000 cars with them, as well as supplying large quantities for other purposes.

The suit brought by the Pressed Steel Car Company against the Standard Steel Car Company and its president Mr. John M. Hansen, has been dismissed. It was brought to recover possession of drawings and patent rights for steel cars which were alleged to have been fraudulently taken by the defendant when he left the employ of the Pressed Steel Car Company to organize the new concern. Judge Joseph Buffington rendered the decision in the United States Circuit Court at Pittsburgh, March 7 and the Pressed Steel Car Company was ordered to pay the costs. It is stated that other suits are pending and that the one referred to may be appealed by the plaintiffs.

One of the interesting features of the new plant now being erected by the B. F. Sturtevant Co., at Hyde Park, Mass., is an elaborate testing plate for its engines. With an output of a thousand engines or more per year this is the essential climax of a careful system of manufacture and testing. The plate, or more properly the plates, will be supported upon a series of heavy parallel walls between which steam and exhaust pipes are carried so that at almost any point in the entire area of the floor measuring about 30 ft. by 60 ft. steam and exhaust connections may be made to any engine, and a transfer crane overhead will make it easy to locate or remove the engines. The same crane will transport them to the packing department, and thence load them directly upon cars which traverse the end of the building.